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VARIOUS FORMS OF  
HYSTERICAL OR FUNCTIONAL  
PARALYSIS //

BY

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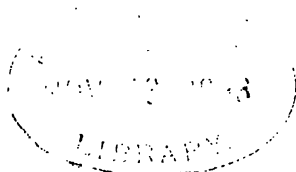


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## PREFACE.

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THE nucleus of this little book was published last year in the *Lancet* in the form of four lectures. The records of several new cases have now been incorporated, and the discussion of the subject has, in reference to some points, been still further developed. I have also added three Appendices dealing with the scientific foundations upon the basis of which, together with careful clinical observation, the views here expressed have been gradually built up.

My best thanks are due to those House Physicians and Clinical Clerks at the National Hospital for the Paralysed and Epileptic, and at University College Hospital, who have aided me by their excellent reports of the majority of the cases here recorded. These reports have been only slightly re-shaped and somewhat condensed. The names of my assistants and fellow-workers have in each instance been added to the cases which we have studied together.

In order that such records may be of real use they should, in my opinion, be reported in considerable detail, and not in the mere outlines which are so commonly employed for the reports of "hysterical" cases. For if we are to arrive at a fuller and more accurate knowledge of the various forms of functional paralysis, this can only be brought about by a continuous methodical investigation and record of all the



minute details pertaining to such cases. With the hope that it may stimulate observation and inquiry in this direction, I have been induced to publish this slight contribution towards the elucidation of a very difficult subject.

MANCHESTER SQUARE,

*December, 1892.*



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# VARIOUS FORMS OF HYSTERICAL OR FUNCTIONAL PARALYSIS.

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## INTRODUCTORY REMARKS.

CASES of paralysis belonging to the functional category are, for many reasons, pregnant with interest. The clinical studies of neurologists are of such a nature as to make them accustomed to the unravelling of complex combinations of symptoms, and the referring of these to one or other form of lesion or functional degradation affecting some particular tract of the brain or spinal cord. But, especially when we have to do with cases of functional disease of the nervous system, we are often more than usually perplexed if we desire to carry out our customary method in diagnosis—that is, if we seek to obtain some rational explanation of the causation and mode of production of the combination of symptoms with which we are brought face to face. Our difficulty would be less, of course, if we were content, as many are, or as others sometimes have to be (however much it may be opposed to their wishes), with a mere tentative or preliminary diagnosis. To say that a given case is one of “hysterical” or “functional paralysis” is at best but a half-diagnosis, and may be a positive error. Again, there may be no evidence or reason whatever for saying that a given case is one of “hysterical paralysis” simply because it seems to belong to the class of functional paralyses. Hysteria is, after all, only one of the general conditions under the influence of which paralyses of a purely functional type may develop themselves. Because a case belongs to the latter category, therefore, we must not on this account look upon it as neces-



sarily hysterical in its origin. But this is what is only too frequently done ; and the danger is that when he does so the practitioner should be apt to think that he is required to go no farther. The error here is a double one : in the first place, it should be recognised, as above indicated, that there are many cases of functional paralysis which cannot be rightly or on any reasonable ground described as hysterical ; and, secondly, whether we make use of the narrower or of the broader term it is equally imperative that no intelligent observer should rest satisfied with a diagnosis which has merely attained this degree, I will not say of perfection, but rather of imperfection.

My justification for speaking thus will be readily appreciated if it be considered that the term "hysterical paralysis" or "functional paralysis," whichever may be used, constitutes only the first approximation to a diagnosis. We merely imply by the use of such terms that we think we are warranted in saying that the case before us is not one which has been caused by any gross organic disease of the nervous system, and that no causative changes therein would be detectable, even with the aid of the microscope. We leave entirely unanswered the other ordinary problems which go to constitute a complete diagnosis ; nothing is implied, that is, as to the part of the nervous system which is at fault, or as to the nature of the process by which its functional activity has been impaired. In other words, the problems of a "regional" and of a "pathological" diagnosis are alike untouched.

But, incomplete as such a diagnosis is, there are many reasons why it should be one which is very frequently arrived at—much more frequently, indeed, than is really warranted. The diagnosis of diseases of the nervous system is often difficult and baffling enough even to experts, and is proportionately more so to those who see less and less of such cases. But, as a matter of fact, for any practitioner, skilled or unskilled, justly to arrive at the diagnosis "functional paralysis," he must face and overcome problems of extreme difficulty. The reason for this is not far to seek ; he may be comparatively familiar with the combination of signs and symptoms the presence of which would warrant him in concluding that he has before him a case, say, of hæmorrhage into the pons Varolii, a case of acute spinal paralysis, or a case of locomotor



ataxy; but how infinitely more complex is the work of memory and reasoning that has to be gone through before he is entitled to come to such a diagnosis as "hysterical paralysis" or "functional paralysis." Such a diagnosis means, when unfolded, that we are satisfied that the combination of symptoms before us is such as not to be explicable by any known or unknown organic disease of the nervous system. But what a very skilled and practical knowledge of nervous diseases is needed before any one of us is in the least degree fitted to come positively to such a negative verdict!

Still it may safely be said that the more slender and insecure is the practitioner's knowledge of nervous diseases the more prone is he to regard what may be to him strange or puzzling cases as instances of "hysterical paralysis" (often enough to the detriment of the patient and his own ultimate discredit); while the wider and more comprehensive is his knowledge of such diseases, the less frequently does he make, or rest satisfied with, such a diagnosis. The much wider experience of the neurologist, in fact, renders him secure against many of the pitfalls into which his less experienced colleague might be betrayed. He has, for instance, a much greater chance of recognising the protean forms of disease to which disseminated sclerosis gives rise; he is similarly less apt to fail to recognise Friedreich's disease, or the paralysis associated with spinal caries, or a case of chronic spinal paralysis, and to believe that he has before him forms of functional or "hysterical" paralysis.

The fact is that to arrive at a thoroughly warranted *positive* diagnosis of "functional paralysis" is often for a time impossible even to one who has a very extensive acquaintance with nervous diseases; at the most such a diagnosis may be regarded as more or less probable. He is not so likely as one with a less extensive knowledge of such diseases to be led astray by the fact that the patient before him is the subject of some of the more common hysterical symptoms. He knows, rather, that such cases require the exercise of more than usual care and discrimination, because of the great frequency with which common hysterical symptoms are associated with those of actual organic disease of the nervous system. He knows, too, that he must not confound the mere



emotional weakness of certain nervous patients suffering from structural disease with hysteria; and must still less suppose that its presence suffices to account for all symptoms, and gives warranty to a facile but erroneous diagnosis of "hysterical paralysis." The strange way, too, in which restitution of function has been known to occur in cases of experimental section of the spinal cord in monkeys (as in the experiments of Mott on the results of hemisection of the cord) should make us very careful how, even in looking back upon clinical histories, we base our opinion that in a given case we have had to do with functional disease merely because of the extent to which recovery has taken place. It must be borne in mind, in fact, that in certain obscure cases a speedy recovery from a set of symptoms, giving colour to a diagnosis that the morbid condition was one of functional origin, may, after all, carry with it no such warranty, since the temporary morbid symptoms may in reality have been due to a thrombosis which after a time resolved. It must not be forgotten, in short, that justly to arrive at a thoroughly warranted diagnosis of "functional paralysis" in any given case is often a matter of the most extreme difficulty, as well in the early as the later stages of its progress. It may, of course, be frankly conceded that in many other cases the problem is much simpler, and the margin of possible error altogether narrower.

To arrive at the conclusion that we have to do with a case of "functional paralysis" is, of course, an all-important matter from the point of view of prognosis and of treatment alike. But, as I have said before, it is not a diagnosis in any proper sense of the term. To make our conclusion in any way complete, we must strive to go some steps further, so as to form a notion as to the region of the nervous system that is at fault, and also as to the nature of the pathological condition which causes a failure of functional activity in the part in question. But the difficulties which beset us are here again extreme.

#### THE QUESTION OF LOCALISATION.

Take, first of all, the question of the region affected in any given case of functional paralysis. A preliminary difficulty



stares us in the face at once. Are these cases partly of cerebral and partly of spinal type? Probably; but as to this there is no certainty, because nothing is definitely known at present as to the real grounds for making any such differential diagnosis. No reason can be assigned why functional failure should not occur from time to time, in favourable subjects, in any part of the nervous system; though, as a matter of fact, it may be perfectly true that some regions are much more prone to experience this failure than others. We have, however, scarcely approached the threshold of anything like knowledge as to this matter. It has long been customary, as is well known, to attribute cases of hysterical paralysis to some defect of "will," and therefore to regard them as presumably due to cortical defects. This sort of interpretation is applicable even where the paralysis is of paraplegic type, and still more where it is a monoplegia affecting one lower extremity. And, as illustrating what I have previously said concerning the difficulty of diagnosing cerebral from spinal cases of functional disease, it may be stated that no rules of any kind are laid down in text-books upon the basis of which we may discriminate whether any such crural monoplegia is in reality due to functional disease of the cerebral cortex, or to functional defect in the lumbar region of the spinal cord. On this subject I hope, however, further on to be able to direct attention to some important characteristics the presence or absence of which may help us to make such a discrimination.

Again, if we take the brain itself, it may easily be recognised how meagre is our knowledge of the symptomatology of functional diseases affecting different regions of this complicated organ. As to the cerebellum, it may fairly be said that we know nothing concerning its functional diseases. While as to the cerebrum, what we know with any approach to definiteness on this subject seems to be limited to three regions; that is, (*a*) to a region involving some portion of the Rolandic convolutions; (*b*) to a region involving the posterior third of the hinder segment of the internal capsule; or (*c*) to a region involving some of the outgoing fibres from these convolutions. As to the symptomatology of functional defects of other regions of the cerebrum capable of producing paralysis nothing is



practically known ; and the obstacles in the way of our obtaining any such knowledge are, of course, extreme—seeing that from the very nature of the affections we are cut off from the means of localisation which hold good for diseases of an organic type, where we have to do with changes that are recognisable either by the naked eye or by the aid of the microscope.

### THE QUESTION OF PATHOGENESIS.

No less extreme are the difficulties in coming to a decision as to the nature of the pathological condition which brings about the failure in functional activity in this or that region of the great nerve centres. Is this failure to be ascribed to imperfect blood-supply ; or is it due to some primary failure in nutritive activity on the part of the nerve elements themselves in the region in question ? The first is undoubtedly the more popular explanation ; still, it is one which is to a great extent unsupported by any distinct evidence in its favour. It implies, in the first place, the existence of vaso-motor nerves throughout the cerebral and spinal vascular system. Very probably these do exist ; still, for the present, actual proof of their existence is wanting. On this subject Michael Foster<sup>1</sup> writes : “ One would be led to suppose that the brain possessed special vaso-motor nerves of its own ; and recognising the importance of blood-supply to rapid functional activity one would perhaps anticipate that by special vaso-motor action the supply of blood to this or that particular part of the brain might be regulated apart from changes in the general supply. The various observations which, however, have been made have failed to demonstrate with certainty the existence of any such special vaso-motor nerves or fibres directly governing cerebral vessels.” He, however, adds : “ It would be hazardous to insist too much on this negative result, especially since the observations have been chiefly directed to the nerves of the neck, the experimental difficulties of investigating the presence of vaso-motor fibres in the cranial nerves being very great.” Bradford’s researches lead him to believe that vaso-motor nerves do exist in the brain, although they constitute

<sup>1</sup> *Physiology*, fifth edition, 1890. p. 1137.



a less developed and effective system than that which is to be met with in the limbs, just as this latter system is inferior in its development to that of the abdominal viscera. A condition of more or less extreme spasm of the vessels in certain brain regions might, of course, be supposed to be a very efficient cause for completely or partially abolished functional activity in such brain regions, and consequently for the production of paralysis, motor or sensory. But the probability of the truth of such an explanation very sensibly diminishes when we bear in mind the fact that paralyzes of this type may last more or less continuously for weeks, months, or even years. It is difficult to understand vaso-motor spasms in brain regions lasting for such prolonged periods, because when we see such spasms occurring in external regions of the body their duration is usually to be measured by minutes, or at most by hours, rather than by weeks, months, or years. It is true, however, that there does seem to be a prolonged, partial, vaso-motor spasm oftentimes in the limbs of one or both sides of the body in these patients (where hemianæsthesia, single or double, exists), if we are to judge from the difficulty in extracting blood by even deep needle pricks on the hemianæsthetic side of the body.

The absolutely sudden onset, or the sudden cessation, of functional paralysis which is to be met with in some cases, certainly points very strongly in favour of vaso-motor spasm as a cause of the affection. And, perhaps, the vaso-motor spasm need not be extreme. It may be that for brain or spinal cord regions to manifest their proper functional activity a full blood-supply is required ; so that if this is diminished by one-half, or even one-third, a very distinct failure of function may be the result. It may happen that the amount of blood supplied to the affected ischæmic brain or spinal cord region is only just sufficient, in many cases, to enable its nutritive condition to be maintained ; while in other cases the amount of blood supplied may be even too small for this, so that actual degradation of structure results—a degradation sufficient to prevent proper functional activity, yet not perhaps sufficient to result in changes easily detectable by the aid of the microscope, even if the opportunity were forthcoming. In cases of the former type, the abrupt recoveries that occur in some



cases where we have to do with functional paralysis are explicable enough; and, on the other hand, where we are concerned with cases of the latter type we may expect that recovery will (as is so often the case) be much more slow and protracted when the disease has been of long duration. For even after the primary cause (the vascular spasm) has been made to disappear, it is still necessary, before functional activity can be properly manifested, to restore to the previously starved tissues the nutritive standard suitable for healthy activity.

If we do not appeal to a primary vaso-motor spasm as the cause of the functional paralysis, our difficulties seem to increase rather than to diminish. Yet such an explanation seems decidedly less probable where, as not unfrequently occurs, the paralysis in question is of gradual onset. But, as I have said, a primary limited failure of nutrition, not of ischæmic origin, but entailing a diminished flow of blood merely as a consequence, is still more difficult to understand. Such local failures of nutrition may, of course, occur independently of a primary vascular 'change, but of this, as a fact, we know nothing. Nor is it easy to imagine what the determining cause of any such localised nutritive failure can be.

Still, it must be recognised that the activity of nervous elements differs in different individuals, and, moreover, that it seems to differ also in different parts of the same brain as a matter of original endowment. In other words, we know that different individuals vary notably in the excellence of their nervous endowments (dependent as this may be, in part, upon varied excellence in degree of organisation; and, in part, upon a different intrinsic excellence in the molecular structure and activities of the nerve elements themselves); and similarly, that the different powers or faculties of the same individual may be of very various degrees of excellence because of differences of organisation or of intrinsic activity of nerve elements in related areas of the brain substance. The celebrated musician has one set or system of nerve elements of surpassing activity and sensitiveness; just as the celebrated painter or the celebrated mathematician may have other sets or systems of nerve elements of surpassing sensitiveness.



Such connate and inherent differences in intrinsic activity of nerve elements in more or less adjacent parts of the brain may exist quite independently of local variations in vascular supply as a cause thereof. The conditions are not exactly comparable, but there is perhaps some resemblance between the physiological and the pathological differences, if we assume that the original standard of nutrition may not be maintained, that it may in fact become degraded locally at times in some individuals, for no assignable reason, and quite independently of any primary alteration in the blood-supply to the part. I say "primary," because a lowered nutritive activity would infallibly entail, as a sequence, a lowered blood-supply. The old maxim, *ubi stimulus ibi fluxus*, seems to be one which is pre-eminently true in regard to nerve tissues, so that an exaltation or diminution of functional activity in any part of the brain or spinal cord almost inevitably carries with it a corresponding increase or diminution in the amount of blood brought to the part.

The predisposing conditions favouring the advent of these functional variations (which are very much more common in females than in males) may be either congenital or acquired, or both sets of conditions may be operative in the same individual. The congenital conditions consist, in the main, in the inheritance of a neurotic temperament; while among the acquired conditions which predispose to functional paralysis may be cited anæmic and lowered constitutional states such as may be left after the prolonged nursing of some relative associated with anxiety and disturbed sleep, or after the occurrence of some acute disease. In other cases they follow upon disappointed affection or upon some traumatism or mental shock; or, again, they may be the immediate sequences of some attack of hysterical convulsions.

After these preliminary remarks we may now turn to a consideration of the characters distinguishing some of the different types of "functional paralysis." It will be advantageous first to deal with some of those of a cerebral type; and secondly, to consider some of those forms which may fairly be deemed to be rather of spinal origin.



### CASES OF FUNCTIONAL PARALYSIS OF CEREBRAL TYPE.

#### (A) CASES DUE TO DEFECTIVE FUNCTIONAL ACTIVITY IN SOME PORTION OF THE ROLANDIC CONVOLUTIONS, COMPRISING THE KINÆSTHETIC AREA (THAT IS, THE SO-CALLED "MOTOR AREA").

The first case of this type to which I have to refer is one of a very rare kind (so far as present records go), and exceedingly interesting because of the light that it helps to throw upon the real functions of the convolutions in the so-called "motor area," as well as upon the actual physiology and mode of production of voluntary movements. It is well known that, following the teachings and experiments of Hughlings Jackson, Ferrier, and others, there was for some time a very general consensus of opinion that these convolutions contained "true motor centres" concerned with the execution of voluntary movements. This interpretation, however, I and others have from the first opposed. We have denied that any satisfactory evidence exists to prove the presence of real motor centres in any part of the cerebral cortex. We have denied, moreover, that there is any physiological or psychological reason for postulating the existence of any such centres.<sup>1</sup> I have asserted, on the other hand, that a special class of sensory centres—namely, those registering kinæsthetic (sense-of-movement) impressions—are really needed in the cerebral cortex to do the work, or an essential part of it, that is supposed to be performed by the hypothetical and altogether imaginary cortical "motor centres" which have been so much spoken of for the last twenty years.<sup>2</sup> I have further endeavoured to show that these kinæsthetic centres for different parts of the body are located, just as the corresponding

<sup>1</sup> *The Brain as an Organ of Mind* (1880), pp. 581—588.

<sup>2</sup> *Brain*, April, 1887, pp. 75 *et seq.*



motor centres were supposed to be, in different parts of the Rolandic and mesial convolutions.

In short, if all the experimental and clinico-pathological facts be accepted on both sides, the question of interpretation still remains. Do the convolutions in question contain simple motor centres, or are they rather sensory centres of a kinæsthetic order? Ferrier, and those who think with him, say they are motor and motor only; I, on the contrary, maintain that they are sensory, that they are, in fact, all-important centres in which impressions derived from, and occasioned by, movements are registered.

There is fortunately one means by which this doubt may be resolved. According to Ferrier, the loss of functional activity in these convolutions results in a loss of motility only; that is, a motor paralysis without coincident impairment of any mode of sensibility. I, on the other hand, maintain that the loss of function in these convolutions entails a loss of muscular sense in corresponding parts of the body, and that the motor paralysis that exists is produced by, and is directly consequent upon, this loss, for reasons which I have elsewhere defined. Victor Horsley, in an able article, has recently proclaimed himself a convert to the truth of this interpretation, as well as to the reasons upon which it is based. He says<sup>1</sup>: "With the object of concentrating attention on the vital importance of grasping the causal nexus between these sense-impressions of movement and the actual subsequent motion, Bastian coined the term 'kinæsthesia,' meaning thereby the sense of movement—i.e., the sum of all the sensory impressions just referred to; and, further, he, in addition, postulated the view that such kinæsthesia, or sense of movement, strain, effort, etc., must naturally find its seat or localisation in the so-called motor or Rolandic region of the brain, since undoubtedly voluntary impulses issue therefrom. It is this postulate which embodies the great importance of kinæsthesia, or the so-called muscular sense, to psychology and neurology, and it is this relationship which it is hoped may be considered to be demonstrated by the facts now to be related." V. Horsley has been influenced largely by the observation of cases of cortical disease, and by the fact that in the various operations

<sup>1</sup> *The Nineteenth Century*, June, 1891, p. 859.



which he has performed for the removal of portions of the cortex in the human subject from the Rolandic area he has found loss of muscular sense in the corresponding part; and especially when the arm centres have been removed, because it is in the upper extremity that the presence or absence of this endowment can best be tested.

The case about to be related seems to show the same kind of defect resulting, not as a sequence of structural disease, but from a functional degradation in the so-called arm centres. Charcot has recorded several allied cases of a very interesting kind, though in them other modes of sensibility were just as gravely affected as the muscular sense. In my case these other modes of sensibility were scarcely at all affected at one time, and subsequently only to a minor extent. The reason of this important difference will be referred to further on.

CASE I.—Rhoda R——, aged twenty-three, a nurse in one of the large London hospitals, was admitted into the National Hospital for the Paralysed and Epileptic under my care on April 10th, 1889. (Dr. Risien Russell.)

*Previous history.*—Eleven weeks ago she fell heavily on her right shoulder while going upstairs, and when seen on the following day there were bruises and ecchymosis with extreme tenderness at one spot over the outer end of the clavicle; movement was limited and caused great pain; there was slight crepitus, but no displacement. "Fractured clavicle" was accordingly diagnosed and treated; no attention being paid to motility or sensibility at the time. When "taken down" a month after, she could move the right hand and forearm freely, but not the upper arm or shoulder. This was thought to be due to slight stiffness resulting from fixation. She was encouraged to move it gradually, by a mark on the wall, and some passive movements were employed daily, but no progress was made. At the end of a week the hand and forearm could not be moved, the hand hanging powerless at the side. Some paralysis was now suspected, and it was found that when the arm was held up at a right angle it would fall very slowly and gradually. Slight rigidity was noticed on suddenly raising or lowering it. Sensation was absent all over the limb, pins could be stuck into it without causing any pain, and no bleeding followed their removal; only pressure was appreciated. When told to move her arm no movement resulted, but the opposite side of the body was forcibly flexed laterally, as though an effort were being made to support some



heavy weight from the shoulder. An electrical examination showed no diminution in excitability in the muscles, which responded readily both to the faradic and to the galvanic currents, and equally so on the two sides. But faradism seemed to cause great pain even with an extremely feeble current. She was subsequently treated with faradism, the cold douche, and massage, but without any improvement, though she stated every morning she was "much better." (The foregoing notes were kindly sent to me by Mr. Ernest E. Lewis, house-physician to Dr. Coupland, after the latter was good enough to transfer this patient to my care.)

After admission under my care, the patient herself added the following particulars. She confirmed the account that she was at first, after the removal of the bandages, able to move all parts of the arm feebly, except the shoulder. The arm then began to feel very heavy, and as if very large; it also tingled very much. This condition persisted a few days, and then she found that the arm was quite powerless, and that she could not feel when it was touched. The day before she lost power and feeling in the arm the subjective sensations were very much worse, and the arm ached a great deal. On awakening the next morning she found it in a helpless condition. She remained in much the same state till ten days ago, "when feeling returned, and since then a little power of movement." She says she had previously enjoyed very good health; she had suffered from no nervous diseases, nor was there a neurotic family history, except that a younger sister became paralysed on the right side after fits when teething, though she is now well, and has had no recurrence of the convulsions.

*Present Condition.*—The patient is a well-nourished, healthy-looking young woman, complaining of loss of power in the right arm. The arm is wasted to a very trifling extent as compared with the other, and the muscles are slightly less firm. Patient can shrug the shoulder, but otherwise cannot perform any of the movements of the arm or hand. When she tries to move the fingers or thumb of the right hand there is just the slightest visible result (a slight tremor in the fingers she is trying to move). No rigidity, and passive movements at all the joints are free and painless. The reflexes at the triceps and the wrist are a little more free than they are on the left side. Sensibility to touch and pain not affected; she feels just as well as on the left arm.<sup>1</sup> Muscular sense is greatly impaired; thus with eyes closed she cannot say whether the right arm is straight or flexed at the elbow, or whether the fingers are

<sup>1</sup> These notes were made by Dr. Risien Russell, who was at the time one of the resident medical officers.



extended or flexed. She seems, in fact, to have no idea of the position of this limb,—merely says she feels it touching something, but cannot say what. When tested in the same way with the left limb, she knows accurately and at once its exact position, and also that of the fingers. Electrical reactions: All the muscles of the shoulder, arm, and hand respond to a weak faradic current, and also to the continuous current—K.C.C. being greater than A.C.C.

Facial movements are equal on the two sides, and the tongue is protruded straight. The lower extremities are unaffected. Reflexes: Organic normal; plantars very active; knee-jerks active; ankle clonus not obtained; epigastric and lower abdominal reflexes active. Eyes: Pupils equal, and react to light and accommodation; no ocular paralysis; no nystagmus; optic discs normal.

Heart sounds normal; no murmur; action regular. Lungs: Nothing abnormal. Abdomen: Nothing abnormal. Urine acid, sp. gr. 1025; no albumen; no sugar. Menstruation regular. She was ordered *Mist. Quiniæ* ʒj. three times a day; faradism to the right arm daily; also the wire-brush and massage.

April 18.—(Examination made and notes dictated by Dr. Bastian.) After some simple passive movements with the left arm, the patient being blindfolded, she knows exactly the position in which the limb is left. But when similar passive movements are made with the right arm, and the limb is left strongly flexed at the elbow and wrist, she cannot say in what position the limb remains. She adds, "I don't see how I can say," and in reply to the question whether the limb is bent or straight, she says, "Is it straight?" When two or three passive movements were made in succession with the left arm she could afterwards say what movements had been executed; but when a similar trial was made with the right arm she was quite unable to specify the movements that had been executed, merely saying that she felt "a movement at the shoulder," and could feel that the limb was touched. Again, when the right hand is manipulated and the fingers are left in a flexed condition, she is quite unable to say whether they are bent or straight. When the left hand is similarly manipulated, she tells at once without hesitation which fingers are bent or extended. Her power of ideally recalling movements of the right arm seems to be equally defective. When she is asked if she can imagine touching the tip of her nose, the top of her head, or her ear with the left forefinger she answers at once, "Yes." When asked, on the other hand, whether she can imagine similar movements made with the right arm and hand, she hesitates, makes no reply, and when pressed for some answer says, "No, I can't." Again, when asked whether she can



imagine herself playing on the piano with the left hand, she at once says, "Yes;" but in regard to the right hand she gives the same negative reply as before. Tactile sensibility over the right arm and hand seems to be not quite so perfect as it is on the left side, but it is scarcely appreciably impaired, and slight touches can be perceived. Sensibility to painful impressions is very slightly altered—e.g., she calls a slight prick with a pin on the right hand or arm a "pinch"; while on the left side she recognises it at once as a prick. Sensibility to differences of temperature is also diminished over the right arm and hand; thus, a moderately hot body feels like a simple touch, though a cold body is more distinctly felt as such.

April 22.—Sensibility to slight touches is rather more blunted, as is also the sensibility to pain in the right upper limb. Thus, the prick of a pin is now only perceived as pressure, and not even as a pinch. As a rule also she localises wrongly; thus, over the back of the hand and the lower one-third of the forearm she refers too high, while above this sometimes too high, but as a rule too low. She takes a long time to make up her mind as to whether a hot or cold test tube is touching her, but answers correctly in the end. No improvement as regards the sense of position of limb. More signs of returning motor power, but as yet no definite movements.

April 23.—(Note by Dr. Bastian.) Being blindfolded some passive movements were executed with both arms, leaving the right limb extended by her side. When asked to touch with the left forefinger her right elbow she moved it towards the shoulder; and when asked in the same way to touch her right thumb she moved her left forefinger towards her elbow, and then downwards along the limb to the thumb. Ordered a tepid needle bath three times a week, and a stronger faradic current to the arm.

May 2.—More motor power; she can raise the arm better, and can flex it, but cannot extend it at the elbow. No movement at wrist or of fingers yet. Muscular sense and sense of position continue much as before. She has no idea where the arm is in bed after she has been blindfolded and a few passive movements have been carried out to confuse her. She cannot say if the fingers are flexed or extended. When the elbow is flexed she has no idea of its position; when extended, she says, "I think it is straight." Tactile sensibility and sensibility to pain much more blunted. She cannot feel coarse touches and hard pricks on back of hand or fingers; can, however, on thumb, but she refers it to wrist. More blunting in lower third of forearm than above. When touched at middle of forearm she refers it to elbow; when touched at wrist she refers it to middle of forearm. Always goes too much to left before she



comes on arm. Cannot appreciate any differences of temperature on hand, and is very uncertain over lower third of forearm; above this level her answers are correct. When asked how she is, she always says she is "better." When asked whether she can perform certain movements with the right arm she always replies, "Oh, yes, I think so," and makes an attempt to carry out the movement. She has never once said that she is not so well, or that she is unable to do what one asks her to do.

May 17.—She left the hospital contrary to advice; having after the receipt of a letter from her mother a few days previously become possessed by a very strong desire to return to her home in Devonshire. No very appreciable alteration in her condition had taken place from that which is recorded in the above notes.

June 21.—In reply to a letter of inquiry from me the patient wrote as follows: "I am glad to be able to tell you that I have regained the power over my arm. Two of my fingers are close together, but I think it will come right in time; it does not prevent me from doing any work. I have had it rubbed morning and evening, also cold sea-water baths daily, so do not think it necessary to come to the hospital just now."

This case seems to be a good example of what Charcot terms a "traumatic brachial monoplegia." It developed not abruptly, but gradually some time after a blow upon the shoulder, and was characterised during the eleven weeks that the patient was under observation by a flaccid paralysis of the whole of the arm, by the absence of any marked muscular wasting, by the presence of normal electrical reactions, by only slight exaggeration of the deep reflexes, by loss of the muscular sense, by mere impairment of other modes of sensibility,<sup>1</sup> as well as by an error in the localisation of tactile impressions of a definite kind. But these are exactly the kinds of defect which, as Victor Horsley has recently pointed out, are to be met with as a result of disease in the kinæsthetic or so-called motor area of the cortex. Thus, speaking of the effects of a paralyzing lesion situated in a portion of the upper limb area

<sup>1</sup> It will be seen from the notes that at first there was a much more marked loss of sensibility than existed when the patient first came under my observation; and during the time of her stay in the hospital there were several fluctuations in the degree of anæsthesia existing. This I believe to have been due to the coexistence of a slight functional defect in the hinder portion of the internal capsule.



of the cortex—viz., the focus concerned with the movements of the thumb,—he enumerates them as follows : “ (1) Insensibility to slight tactile impressions on the thumb, (2) inability to localise correctly moderate tactile impressions on the thumb, (3) subjective sensation of numbness and cold in the thumb, (4) ignorance of the position of the thumb in space unless the eyes are directed towards it, (5) paralysis of voluntary movement of the thumb.”

My contention is that in this case, as in others in which there is actual organic disease of the Rolandic area of the cortex, the paralysis met with was directly due to the functional inertness of the kinæsthetic centres there situated, and to the fact therefore that all-important neurological processes—viz., the revival of previous kinæsthetic impressions from the part of the limb affected—were no longer capable of being produced. Without such a revival (since the molecular movement liberated thereby is the means by which the executive bulbar and spinal motor centres are set in action) a voluntary movement can no more take place than a gun can be fired without the pulling of its trigger.

This was the first case of the kind I had had the opportunity of examining after fully realising the consequences of my own views as to the real nature of a case of so-called “hysterical paralysis.” It was with much interest therefore that, in the presence of our then senior resident medical officer, Dr. Taylor, I tested this patient as to her ability to recall in idea movements of her paralysed arm. This ability was found to be absent, as the note then made (April 18th) shows. But such paralysis and inability to recall movements in idea, which is found in association with loss of muscular sense in cases of structural or functional disease of the kinæsthetic centres, is not by any means necessarily present in all cases where there is loss of muscular sense. All-important differences are met with according as the loss of muscular sense is dependent upon diseases of a functional or structural type involving the *afferent tracts* for kinæsthetic impressions ; or as it is dependent upon disease involving the *cortical centres* for such impressions.

It is in the latter case only that we have a right to expect as consequences a corresponding motor paralysis, together



with an inability to recall corresponding movements in idea. A forgetfulness or failure to recognise this important distinction on the part of several writers has given rise to much confusion.<sup>1</sup> It is the mere afferent channels for these and other sensory impressions that are affected in a great majority of the cases of profound hemianæsthesia, and in them there need be neither the existence of paralysis nor of any inability to recall movements ideally. Still, as a matter of fact, these two groups of symptoms often go together—that is, we may have patients suffering from profound hemianæsthesia and at the same time from paralysis of the affected limbs. The occurrence of such a combination may, as we shall afterwards see, be accounted for in different ways ; but one, and that the most probable, mode of explanation is to suppose that both afferent channels and some portion of their cortical centres are simultaneously affected by the same kind of nutritive depression.

(B) CASES DUE TO DEFECTIVE FUNCTIONAL ACTIVITY IN THE POSTERIOR THIRD OF THE HINDER SEGMENT OF THE INTERNAL CAPSULE.

It has now been conclusively proved by clinical as well as experimental evidence that what is known as “cerebral hemianæsthesia” is caused by lesions of the posterior third of the hinder segment of the internal capsule—viz., that part of the foot of the corona radiata which lies between the optic thalamus and the posterior part of the lenticular nucleus. This part of the brain is supplied with blood by the lenticulo-optic branches of the middle cerebral artery. Hæmorrhages and softenings are the common organic lesions occurring in such a situation.

It has now been equally well established, however, that a condition in every way similar, except that it is apt to be fluctuating in its severity and altogether irregular in its duration, is met with at times—in girls and women more especially, though occasionally also in men—as a result of mere functional disturbance, presumably in the region above mentioned, though independently of all discoverable lesion: that

<sup>1</sup> See *Appendix A*, p. 165.



is, none has been discovered in cases in which there has been an opportunity for making an autopsy. Variations naturally exist as to the completeness and the degree of hemianæsthesia of the head, trunk, and limbs, when the condition is due to an organic lesion; but precisely similar variations are often met with when the condition is of functional origin.

Thus, it is not in all cases of either category that the special senses are involved. But in the complete and typical forms of cerebral hemianæsthesia all the special senses are affected. Not only is there loss of taste in the corresponding half of the tongue, and loss or impairment of hearing on the same side; there is, in addition, loss or impairment of vision and of smell on the affected side. The defect of vision is peculiar; we have to do with a more or less pronounced amblyopia, in which the acuity of vision may be reduced by one half or even more. The ophthalmoscope shows no changes in the fundus of the eye; and the pupil remains normally sensitive to light; because the defect occurs in the visual tract beyond the corpora quadragemina, and these contain the reflex centres upon which the activity of the pupil depends. There is a concentric and general contraction of the visual field; and lastly there is also a concentric and general contraction of the visual field for colours. This contraction of the visual field for colours, indeed, often occurs, as Landolt pointed out, in both eyes, though to a much more pronounced extent on the side affected with anæsthesia. First the circle for violet becomes contracted to nothing, so that the patient fails to perceive this colour; then, as the disease progresses, green, red, and orange follow in turn; the perception of yellow and blue persisting until the last. Finally in the most advanced stages, and in some subjects (not often to be met with in this country, though more common in France), no colours can be detected—tinted objects presenting to the patient an appearance in monochrome similar to that of a sepia drawing.

In other cases, instead of the defect of sensibility occupying the whole of one half of the body, it may stop short altogether about the head and neck. Again, frequent variations occur in the degree or depth of the hemianæsthesia; in some cases this loss of sensibility is limited to the skin and mucous membranes, while in others it involves also the deeper



structures of the limb, so that all its parts are entirely deprived of sensibility.

In this latter class of cases there is always a complete absence of muscular sense and of kinæsthetic impressions generally. Even in these extreme cases, however, there is no motor paralysis so long as the disease is limited to the region of the posterior third of the internal capsule. But when the eyes are closed in such cases, there is more or less uncertainty and lack of precision about the movements performed by the affected parts. We have to do, in fact, with sensory paralysis, no motor paralysis, and only a certain amount of ataxy when the eyes are closed.

The effects of this deeper, but rarer, kind of hemianæsthesia may be best illustrated by an example.

CASE 2.—Demeaux<sup>1</sup> gives details concerning a woman suffering from hemianæsthesia, which show the complete loss in her of the sensations coming from muscles, as well as of all other modes of sensibility, superficial and deep, in the affected limbs. He says:—“She put her muscles in action under the influence of her will, but she had no consciousness of the movements which she executed; she knew not what was the position of her arm—it was impossible for her to say whether it was extended or flexed. If one told the patient to raise her hand to her ear, she executed the movement immediately; but when my hand was interposed between her own and the ear, she was not conscious of it; if I stopped her arm in the midst of its movement, she did not become aware of it. If I fixed, without allowing her to be aware of it, her arm upon the bed and told her to raise the hand to her head, she strove for an instant and then became quiet, believing that she had executed the movement. If I induced her to try again, showing her that her arm had remained in the same place, she attempted to do so with more energy, and as soon as she was compelled to call into play the muscles of the opposite side [of the body], she recognized that the movement was opposed.”

Sometimes cerebral hemianæsthesia may be double, and more or less complete on each side of the body. An interesting example of this type has been recorded by Strümpell.<sup>2</sup> He says:—

“In the autumn of last year there was received into the

<sup>1</sup> *Des Hernies crurales*, Thèse de Paris, 1843, p. 100.

<sup>2</sup> *Pflüger's Archiv*, vol. xv., p. 573, and *Nature*, Dec. 13th, 1877.



medical clinic of Leipzig a youth aged 16, in whom various phenomena of anæsthesia gradually developed themselves to an extent which has very rarely been observed. The skin of the whole surface of the body was completely insensible, and that in respect to every kind of sensation. The most powerful electric current, or a burning taper held to the skin, was not able to produce any pain, or even a sensation of touch. Almost all the accessible parts of the mucous membrane of the body exhibited the same insensibility to pain. Also, all those sensations which are classed together under the name of 'muscular sense' were entirely absent. The patient, when his eyes were closed, could be carried about round the room, his limbs could be placed in the most inconvenient positions, without his being in any way conscious of it. Even the feeling of muscular exhaustion was lost. In addition, there came on also a complete loss of taste and smell, amaurosis of the left eye, and deafness of the right ear. . . . In short, here was an individual whose only connection with the outer world was limited to two doors of sense—to his one (right) eye and his one (left) ear."

It is important to bear in mind that in some cases no distinct hysterical manifestations, or other unmistakable symptoms pertaining to such a state, are to be found coexisting with what appears to be a functional hemiplegia. In some of these latter cases there has been an association with lead-poisoning (Raymond).

In other cases a hemianæsthesia, either superficial or profound in type, constitutes one element in a more or less typical grouping of hysterical symptoms; and when there is the association of convulsions of a peculiar type we have to do with *Hystero-Epilepsy*, or with what Charcot terms "*la grande hystérie*," or *hysteria major*.

As I have already intimated, it is not in all cases of hemianæsthesia, either of organic or of functional type, that all the special senses are involved. And where there is an absence of implication of sight and smell we lack the distinguishing characters that specially differentiate this "cerebral" form from what is known as "*mesocephalic*" hemianæsthesia, due to disease in the cerebral peduncle or in the pons.



(c) CASES DUE TO AN ASSOCIATED DEFECTIVE FUNCTIONAL ACTIVITY IN THE SENSORY SEGMENT OF THE INTERNAL CAPSULE AND IN THE CORTEX.

It seems often to happen that functional disease is not strictly limited to this sensory region of the internal capsule. The defective nutrition, whatever its precise nature, appears apt to involve it and, simultaneously, portions of the Rolandic area of the cortex constituting the termini for the afferent channels conveying kinæsthetic impressions: and when this cortical defect coexists, a motor paralysis of the related limbs becomes established. As with the affections of the posterior part of the internal capsule alone, so with these associated affections of the cortex, they are apt to occur with different degrees of intensity.

One result of this is the production of two categories of paralytic disability. There are, in fact, on record (1) several instances of a very extraordinary grouping of symptoms—cases in which there is a complete or partial hemianæsthesia, associated with a motor paralysis only so long as the eyes are closed or the part to be moved is not seen; while there are a very much larger number of recorded cases (2) in which, with a similar complete or partial hemianæsthesia, there is the association of a motor paralysis, existing as much when the eyes are open as when they are closed. A few words must now be said concerning each of these combinations.

**1. Hemianæsthesia with Paralysis only when the Eyes are Closed.**

So far as I know, Duchenne<sup>1</sup> was the first person to call attention to this remarkable affection. After speaking of the much more frequently occurring cases of hemianæsthesia of the previous type, in which loss of muscular sense exists without paralysis of the limbs affected, he goes on to speak of another category of cases in the following terms: "In the second category, which is much less numerous, the patients when similarly deprived of sight lose the faculty of executing the simplest voluntary movement. If they are bidden, for example, to open or shut the hand, flex or extend the forearm

<sup>1</sup> *Moniteur des Hôpitaux*, 1853; and *De l'Électrisation localisée*. 1855, pp. 410 and 417.



—in a word, whatever movement one asks them to perform,—the muscles which ought to enter into contraction remain inert, notwithstanding all the efforts of the will. One only observes sometimes certain irregular movements, slight in extent, weak, and different in kind from those that they wish to execute—movements of which they have even no knowledge. Nothing can describe their astonishment when they perceive after the experiment that their limb has remained in the same situation when they thought they had made it execute a movement. Their surprise is all the more great, since they can execute the same movement with rapidity the instant that they are permitted to look at the limb.”

In confirmation of these statements, Duchenne gives a detailed account of a patient in La Charité under the care of Briquet, whom they conjointly submitted to repeated careful examinations. The description given by Duchenne of this remarkable case was subsequently entirely confirmed by Briquet. Some quotations from his account are here subjoined.

CASE 3.—“There was also another phenomenon which M. Briquet and I observed in this case of general and profound insensibility : that is, one could violently strike her limbs, shake them violently, and change their place, without her having any knowledge of it. . . . On devoting myself to the examination of this patient I found that she presented in the highest degree the phenomena which constitute the special object of this article. Thus having stooped in such a manner as to prevent her seeing her hand at the moment when I told her to close it, the hand remained motionless though she thought she had closed it ; and, whilst I was making her extend and flex the forearm upon the arm, having turned her attention away from this limb the movement was immediately arrested—the limb remaining in position as if it had been tetanised. I should add that the patient, whom I had seen for the first time, was quite ignorant of what I sought to establish. . . . But here is another experiment which shows, in addition, that the action of the will in combination with the sense of sight was necessary also for the cessation of a contraction once produced. If after having made her squeeze the hand, she is prevented from seeing it, and told to cease all effort, one feels that the contraction of the flexors continues, and it is necessary to employ considerable force to open her hand. Or if, after having made her flex the forearm, one prevented her seeing it, the forearm remained in a state of flexion, and it was necessary to employ a



pretty strong force to extend it (it must be recollected that the patient, deprived of all sensibility, had no consciousness of the movements which were impressed upon her limbs").

"Here, again, is another experiment which shows that it is not sufficient for the patient merely to be able to see in order that the movement should be obtained, but that it is also necessary for her attention to be fixed upon the limb about to be called into movement. Having placed the patient's hands sufficiently close to one another so that she was able to see them both equally well, I asked her to shut them and to open them both at the same time. The flexion was executed, but alternately on the two sides; and it was the same in regard to the extension. She was not able to contract homologous muscles at the same time, whatever effort she made to obtain such a result. One could see that during the contractions she alternately fixed her attention upon the hand about to be called into movement. It was no longer possible for her to flex or extend simultaneously both forearms." This patient remained under observation for many months without any notable change in her condition.

Briquet gives the details of another case,<sup>1</sup> just as extraordinary as that recorded by Duchenne; this patient having been under his care for nearly twelve months in La Charité. Here are a few quotations extracted from his report :—

CASE 4.—The patient was a girl, 21 years of age, suffering among other things from complete loss of taste, from noises in the ears, and from amblyopia especially on the left side.

"The skin of the whole periphery of the body is completely insensible; the patient absolutely does not feel anything which she touches.

"The muscles of the limbs do not feel pressure; they require to be pressed strongly against the bones before the patient feels anything. Passive movements are not at all felt, so that the patient has no consciousness of them if sight does not intervene.

"In short, the anæsthesia of the surface of the body is so extreme that, having bandaged her eyes, the patient has been taken from her bed with only her night-dress on, placed upon the floor of the ward, where she has been left a few moments, and then replaced in her bed, without her having any consciousness of what had been done. The patient describes her condition by saying that she is

<sup>1</sup> *Traité de l'Hystérie*, Paris, 1859, p. 304.



like a balloon suspended in the air. She has only the sense of sight, which is weak, and that of hearing, which is just as bad.

"The muscles of the upper extremities are notably weak, nevertheless the patient can sew pretty well; she moves her fingers and hands well, but *if one prevents the intervention of sight no movement is any longer possible: whatever may be the efforts of the will, there is complete immobility.*

"The lower extremities are still more feeble; the patient can, whilst in bed, execute some movements of the whole limb, but she cannot move the toes, and when she is placed on her legs they immediately double under her, and there would inevitably be a fall [if she were not supported]."

After she had been in the hospital about four months this patient was in some respects better; she could for instance maintain herself in the standing position when supported on each side, but as regards her knowledge of passive movements, and of the position of the limbs, there was no improvement whatever.

Fortunately I have been able to find the record of another case recorded by Bazire,<sup>1</sup> very similar to those reported by Duchenne and Briquet: only here we have to do with hemianæsthesia rather than with general insensibility. There is also the important fact that it occurred in a man rather than in a hysterical girl; and possibly in part as a result of some slight organic lesion and partly as a consequence of lead poisoning. The actual inability to move when the eyes were closed was in this case, moreover, limited to the lower extremity; though the power of moving the upper extremity under the same conditions was much more than usually affected.

CASE 5.—"W. P.—, aged 43, married, a plumber and gas fitter, was admitted into the Westminster Hospital, under Dr. Fincham's care, on April 25, 1865. He is tall, fairly nourished, with a sallow complexion, and there is a faint blue line along the edge of his gums. He has never had gout, rheumatic fever, or syphilis. A year ago he had an attack of lead colic, followed by dropping of the left wrist, which only lasted a few days."

"*Present state* :—There is complete *analgesia* of the whole left half of the body, exactly limited to the median line—namely, of the left half of the head, face, tongue, palate, neck, trunk, and penis,

<sup>1</sup> Translation of Trousseau's *Lectures*, 1866, p. 213.



and the left arm and leg. Pricking and pinching, except in the spots to be presently mentioned, are obscurely felt as a mere contact, and many seconds after the impression is made. The left eyeball is so insensible to pain that the patient rubs it with impunity. The left half of the tongue cannot distinguish sapid substances, and the patient complains of a sensation of heat and dryness, and occasionally of pins and needles in that side of the organ. Instead of analgesia, there is tenderness on pressure in front of the left elbow-joint, and again near the lower edge of the deltoid. Differences of temperature are more acutely perceived on the affected rather than on the healthy side. There is nearly complete *anæsthesia* of the left half of the body, for when any point is touched on that side, the patient becomes conscious of it only after an interval of several seconds, and besides, localizes the impression erroneously. He states that he feels as if through a thick layer of flannel or wool. He does not know the position of his left arm or leg, if he does not see it. *If, when his eyes are shut, he be asked to touch the tip of his nose with his left hand, he visibly makes considerable efforts, but his hand, which is raised with great difficulty and slowness, either stops at a certain height, or goes to one side of the head, never succeeding in touching the nose.* The movement is slow and hesitating, never abrupt or jerked. *When his eyes are shut, he cannot make the least movement with his left leg.* When he walks, he keeps his eyes fixed on the ground immediately before him, not on his legs. His gait is somewhat uncertain and unsteady, but not markedly so. *He cannot walk with his eyes closed; he cannot stand, even with his eyes open, when his feet are closely approximated, and he looks straight before him. If, while his feet are wide apart, he shuts his eyes, he immediately oscillates from before backwards, and threatens to fall down.* He says that he then feels as if he had only one leg.

"There is no real *diminution of motor power* at present, at least beyond a slight depression of the left angle of the mouth, and a scarcely perceptible deviation of the apex of the tongue to the left side. There is no difference of size between the muscles of the right and left limbs; electro-muscular contractility is perfect on both sides, but electro-muscular sensibility is almost *nil* on the left. None of the special senses are affected, except *taste* in the left half of the tongue. Vision is good; the left pupil is, however, appreciably smaller than the right. Hearing is perfect on both sides. The intellect was never affected; memory is very good, and the man gives an excellent account of himself. There has never been any headache, but more or less giddiness throughout. Articulation thick and embarrassed, probably owing to the numbness of



the left half of the tongue and soft palate; but the faculty of language is unimpaired. Appetite good; digestion easy; bowels at present regular, but were formerly very costive. The bladder was never affected.

*Mode of Attack.*—The patient's illness dates from the beginning of September, 1864. It set in suddenly, without any premonitory symptoms, about seven o'clock one morning, with a sense of chilliness and numbness all down the left half of the body. He was not, however, prevented from attending to his usual occupation, until three weeks afterwards, when the numbness was replaced by complete insensibility. There was also some motor paralysis at first, as it appears from his statement; for he affirms that there was real and considerable weakness of his left arm and leg, that his left cheek was pendulous, and that the right angle of his mouth was pulled upwards and outwards whenever he spoke or laughed. Until he was examined by Dr. Fincham, he had not discovered his inability to move his left arm and leg unless he looked at them. Under the influence of faradisation, and the administration of iodide of potassium for a short time, and afterwards of hypophosphite of soda, he gradually improved."

Speaking of these strange cases before the Neurological Society in 1886 I gave the only explanation that I have yet seen of them in these terms: "It seems to me that we here have to do with functional defects in the cortical termini for muscular sense impressions, as well as interference with the functional integrity of the afferent channels for such impressions. These latter are alone affected (in concert with the afferent channels for other sense impressions) in the more ordinary severe cases of hemianæsthesia of the type recorded by Demaux. But in these altogether extraordinary cases of Duchenne and Briquet there existed, I think, in addition a lowered functional activity of the muscular-sense centres. These centres could not be roused into activity by comparatively weak associational stimuli (as during volition with eyes closed), though they were able to respond under the influence of a stronger stimulus from the visual centre.<sup>1</sup> May we not

<sup>1</sup> In this connection it is interesting to find Charcot noting that one of his patients suffering from superficial and deep anæsthesia of the left upper extremity (the limb having previously been paralysed) was able to grasp the dynamometer "with a force of 30 K. when the eyes are open, and only 15 K. when they are closed." *Lectures*, vol. viii. (New Sydenham Soc.), 1889, p. 399.



have in certain hysterical paralyses of cerebral type a still greater functional degradation of these muscular sense centres? Such patients do not move the affected limb or limbs either when their eyes are open or closed."

I still know of no other way in which this peculiar combination of symptoms is to be accounted for. We may find illustrative, though not exactly parallel, conditions among speech defects of an amnesic type, due to a lowered functional condition of the auditory centre. When this centre, for instance, cannot be roused into proper activity by ordinary associational stimuli, the patient, as a consequence, cannot mentally recall the words he wishes; and, as a further consequence, cannot utter such words. This is a real temporary paralysis so far as these speech movements are concerned, although due to a sensory defect. On the other hand, such a patient may be able to repeat at once words uttered before him by another person. The affected auditory centre in this case reacts to the stronger stimulus; just as I imagine the affected kinæsthetic centres reacted in the cases of Duchenne, Briquet, and Bazire, under the influence of stronger associational stimuli (when the eyes were open) coming from the visual centres. Speech takes place under the influence of sensory stimuli proceeding from auditory and glosso-kinæsthetic centres; and a marked defect in either of these sensory centres will lead to paralysis of speech movements, either temporary or permanent according to the nature of the defect. Similarly, limb movements take place under the influence of sensory stimuli proceeding from visual and kinæsthetic centres; and a marked defect in the latter sensory centres will lead to paralysis of corresponding limb movements, either temporary or permanent according to the nature of the defect in question. At present, however, we know nothing of a paralysis of limb movements primarily and directly occasioned by some defect in the visual centre comparable to the paralysis of speech movements above referred to as resulting from a lesion in the auditory centre. Possibly defects so occasioned may be recognised in the future.<sup>1</sup>

<sup>1</sup> Since this was written I have found that the production of such a paralysis has been experimentally demonstrated in the case of lower animals. It has been shown that when the kinæsthetic centres for the limbs have been



## 2. Hemianæsthesia with Paralysis when the Eyes are Open or Closed.

This combination is by no means uncommon, though individual cases vary much in regard to the amount or kind of coexisting motor paralysis. Thus in some cases the paralysis assumes a hemiplegic and in others a paraplegic type; while more frequently still it occurs in the form of a monoplegia, either brachial or crural. In these cases the lack of sensibility, so far as the limbs are concerned, is distributed in accordance with the motor paralysis, and is always found to include a distinct insensibility to kinæsthetic impressions.

The cases that assume a paraplegic type are to be regarded as partial double hemianæsthesias with paralysis; while the monoplegias are to be regarded as partial single hemianæsthesias with paralysis.

Curiously enough, however, it happens that even in the more perfect hemiplegic form of functional paralysis we almost never get a complete hemiplegia; since paralysis of the face and tongue is almost always absent when the paralysis is of such a type. This was long ago pointed out by Todd, and has been abundantly verified since by subsequent observers. As to the cause of such a peculiarity nothing is definitely known; but the case now about to be recorded will be found to be another illustration of this rule, as well as a good type of the *hemiplegic form* of the affection to which this section is devoted.

**CASE 6.**—Carrie C——, aged twenty-three, single, was admitted into the National Hospital for the Paralysed and Epileptic under my care on Jan. 20th, 1890. (Dr. James Taylor.)

*Previous history.*—The patient had an attack of “inflammation of the lungs” in November 1888, and after that she continued very weak and in ill health until March 1889. She then suddenly lost the power of moving the right leg—though this limb had been gradually getting weaker than its fellow since the previous November. She did not lose power in the arm till some time after its loss in the

isolated by division of the associating fibres connecting them with other sensory centres of the cortex, “a paralysis occurs of precisely the same character as that which occurs when they are actually extirpated.” See *Appendix B*, p. 188, Note 2. It might be useful to class all such forms of paralysis (whether of speech or of limb movements) as varieties of “associational paralysis.”



leg, but she was unable to say exactly when and under what circumstances the paralysis of the arm showed itself. In the beginning of March she fainted once, but otherwise had not lost consciousness. She has never had a fit of any kind so far as she is aware. She said that she lost feeling in the leg with the loss of power in March last, but she cannot say exactly when she lost sensibility in the arm. She went into Norwood Cottage Hospital at the end of March, and after six weeks was able to walk with a little help; the power of feeling seemed also to be returning to the thigh, but the arm seemed to be getting worse instead of better. She went to Bexhill Convalescent Home, and there relapsed; gradually losing all power of moving the leg and all feeling in the course of a fortnight. She states that previous to the last three months the affected extremities were flaccid; but that since then they had become stiff. For the last two months she had also had numbness in the palm of the left hand and down the left leg, and the left leg had been getting weak.

She states that she had a fall downstairs in February last (shortly before the onset of the paralysis) and bruised her back, chiefly on the left side, and that she had had pain all down the back ever since. This pain had been much worse during the last month. She has been delicate from a child. Had rickets when a baby; afterwards measles, pertussis, scarlet fever, and typhoid fever.

When seventeen years of age she had an attack of paralysis, affecting the left leg only. This came on also after an attack of "inflammation of the lungs," and she was not able to get about properly for eighteen months after the onset of the paralysis.

*Family history.*—Her father died of an apoplectic fit. Her mother has fits in which "speech is taken and she becomes blue-black in the face." She also suffers from cardiac disease. None of her brothers or sisters are similarly affected, but all of them are somewhat delicate. No other history of fits or paralysis, as far as she is aware.

*Present state.*—The patient is a pale anæmic girl, complaining of inability to move the right arm and leg and of pain all down the back.

Head: No tenderness complained of on pressure or direct percussion. No asymmetry of face when at rest. When asked to perform movements, she goes through various contortions and says she is unable to perform the movements asked for. In showing her teeth, she draws the under lip down on the right side, and raises the upper lip imperfectly, but equally. When asked to open her mouth wide, she purses her lips and makes the orifice as small as possible. Cannot frown, but raises her eyebrows equally. Closes her eyes equally, but



not as firmly as should be. Masseters and temporals act equally, and the jaw drops mesially. No affection of sensibility on either side of the face. Tongue protruded mesially. Palate: Uvula deflected to the right, but arches equal and equally drawn up in phonation. Tactile sensibility of palate blunted and its reflex almost abolished.

Neck: No affection of sensibility on either side. Says she is unable to raise her head off the pillow and keep it off without support. When sitting up and supported, lateral excursions are fairly carried out, but forward and backward movements are very imperfectly executed.

Trunk: Is unable to sit up without support; cannot raise herself from the recumbent position with arms folded across the chest. As regards sensibility, there is well-marked hemianæsthesia of the right half of the trunk; she cannot feel the prick of a pin on this side until it is pushed well in, and then she says it is a touch. Reflexes: Epigastric and lower abdominal very brisk; right, on the whole, more so than the left. Spine: No angular curvature; tenderness complained of on slight pressure being made all down the spine, from the seventh cervical vertebra to sacrum, especially in the lumbar region; also complains of tenderness all over the left hypochondrium and lower axillary region, where nothing abnormal can be detected.

Right arm: Keeps the right arm extended by her side, the hand being flexed at the wrist, with inclination to the ulnar side. Fingers strongly flexed at the metacarpo-phalangeal joints and semiflexed at phalangeal joints, with thumb opposed to side of index finger. The whole upper extremity is held very rigidly, and when raised off the bed passively a rhythmical tremor commences, chiefly limited to hand and fingers. The rigidity is due to muscular contraction, and can be everywhere easily overcome passively. No sign of adhesions in any of the joints, or of contraction of tendons. Every segment of the limb can be passively extended at the same moment. There is no undue wasting of the right arm as compared with the left. Grasps: Right, 0; left, 40. Is unable to perform any movement whatever with this arm. There is complete loss of sensibility to touch and prick in the right arm, and there is also complete loss of muscular sense. When blindfolded she is unable to say in the slightest where her right arm is; she is unable to put the left arm into the same position as the right, and is unable at once to find the arm, much less any individual segment. She is unable, likewise, to say in what position the various segments of the arm have been placed.

Left arm: With this limb she can perform all movements. There is no undue rigidity; she feels touches and pricks of pin



everywhere except on palm of hand and backs of fingers. Can say at once in what position the upper segments of the arm are placed when blindfolded, but is unable properly to recognise the position of the hand at the wrist or of the fingers.

Reflexes: Those of the triceps and of the wrist exaggerated on both sides; the result on the right side would be more but for the rigidity.

Lower extremities: No undue wasting of either. Left leg can be moved at the various segments, but not with any vigour. Its sensibility is slightly blunted. Right leg: No power of movement; foot pointed. Resistance to passive movements is more marked in the right than the left limb; and there is absolute anæsthesia and analgesia, with the same degree of defective knowledge of position of the limb and its segments that exists for the right arm. Reflexes: Plantar present, right less than left; knee-jerks exaggerated, right greater than left. There is a slight imperfect ankle-clonus on first attempt on the right, none on the left side.

Lungs: Nothing unnatural. Heart's action regular; sounds normal, except that at apex a soft systolic murmur accompanies the first sound; second pulmonary sound not unduly accentuated. Abdomen: Nothing unnatural detected. Urine acid, sp. gr. 1018, no albumen, no sugar. Catamenia regular for the last two months, previous to that there had been amenorrhœa for several months.

The patient was ordered Ferri Ammon. Cit. gr. iv., Liq. Strychniæ  $\mathfrak{m}$  iv., Liq. Arsenical.  $\mathfrak{m}$  iij., Sp. Chlorof.  $\mathfrak{m}$  x., Aq. ad  $\mathfrak{z}$  j., three times a day, and to have iodine liniment painted every other day on different portions of the back over the spinal column, together with daily applications of the wire-brush to anæsthetic parts. Subsequently, as the patient was sleeping badly, forty minims of paraldehyde were ordered to be taken at night when necessary; whilst on Feb. 10th a sulphur bath three times a week was ordered. This treatment, with slight occasional modifications, was continued for some time.

March 29.—The patient can now move, the right arm and leg freely at all the joints. Grasp of right hand still very weak. Can stand and take a few steps alone, but is still very feeble and lame. She now moves the right leg forward, but scrapes the foot behind her. Feels light touches on right arm, but does not localise them quite correctly. Muscular sense with sense of position of both arm and leg are now restored. There is still marked blunting of common sensibility over the leg, but a return of sensibility over the right foot. This result was brought about by four vigorous wire-brush applications preceded by statical electricity and the drawing of "sparks" from the affected limbs. Sensibility to the wire-brush



was present in the upper right arm last week, but no change in the muscular sense occurred then. The appreciation of the position of the limbs and their segments after blindfolding occurred simultaneously with the restoration of the power of moving the affected limbs.

April 8th.—Sensibility of right arm and hand is now normal, except perhaps slight blunting of fingers to very light touches. In the leg light touches are not perceived at all. In both arm and leg sense of position is quite accurate. Ordered one drachm of cod-liver oil three times a day; also massage daily to right arm and leg.

April 28th.—She continues to be very anæmic, and her appetite is not good. Ordered Liq. Ferri Perchlor. ℥ xv., Glycerin. ℥ xv., Infus. Calumb. ad ʒj. three times a day; and also two drachms of maltine with cod-liver oil twice a day.

June 3.—Since last note was made the patient has remained in much the same condition—that is, she has been able to use the right arm freely, knitting and doing all ordinary work with her hand, though she says she cannot manage to hold a needle so as to do sewing. She is able to move the right leg well in all directions as she lies in bed. When she is up, however, she walks with the leg kept stiff at the knee; the foot is strongly everted, and the toes barely raised from the ground. She varies, however, from time to time; occasionally dragging the foot very little, at other times markedly. The sensibility of the right upper extremity is acute, while that of the right lower extremity is still blunted—not quite so much so as when last note was made, though still distinctly. Her sense of the position of the limb and its segments is quite accurate. Since May 8th “sparks” have been taken from the leg on alternate days.

Discharged, and sent to the convalescent home at Finchley.

There are several points of interest and worthy of note in regard to this case. First, as to its etiology. The attack appears to have commenced during a period of lowered health left after an illness, said to have been inflammation of the lungs, and to have become suddenly aggravated not long after the occurrence of a shock occasioned by the patient falling downstairs. This sudden onset or aggravation of paralysis, however strange and difficult to account for, is very frequently met with in this class of cases.<sup>1</sup> The patient had always been

<sup>1</sup> See also the next case—that of Elizabeth R. And in reference to the possible determining influence of the shock occasioned by the fall, see Charcot's Lectures, vol. iii. (New Sydenham Society's translation), 1889, pp. 383-385.



delicate, and something of a neurotic history was obtained. In addition to the absence of any paralysis of the face, it may be noted that there was also no anæsthesia of the face or neck. There are no notes as to the condition of the special senses, but this probably indicates that they were unaffected—as they were found to be in a somewhat similar case recorded by Charcot.<sup>1</sup> The slight anæsthesia about the left hand, as well as the blunting of sensibility in the left leg, seems to show that there was the mere commencement of a hemianæsthetic condition also on this side. The hemianæsthesia was, however, extreme in the right limbs and in the right side of the trunk; while the distinct loss of muscular sense in these limbs was associated with a motor paralysis just as marked. It is especially worthy of note, too, in reference to the sudden improvement in the patient's condition recorded on March 29th, that “the appreciation of the position of the limbs and their segments after blindfolding occurred simultaneously with the restoration of the power of moving the affected limbs.” The rapid and marked recovery of sensibility and motor power after the vigorous electrical treatment is also worthy of note. The patient improved slowly after this; but it has to be borne in mind that the paralysis had existed for over twelve months, that the girl was still weak and anæmic, and that the nutrition of the previously affected nerve centres as well as the muscles had to be improved.

Another very typical example of functional paralysis of the hemiplegic type, presenting many points in common with that above related, has been recorded lately by Charcot.<sup>2</sup> Abrupt and complete recovery took place here again after faradisation, but the paralysis had lasted in this case only two weeks.

The next case that I have to record is one of partial double hemianæsthesia, associated with complete motor paralysis of a *paraplegic type*.

CASE 7.—Elizabeth R——, aged twenty-seven, a mantle maker,

<sup>1</sup> *Loc. cit.*, p. 103. In this case a distinct lowering in the temperature of the paralysed limbs was found.

<sup>2</sup> *Clinical Lectures on Diseases of the Nervous System*, vol. iii. (New Sydenham Society's translation), 1889, p. 401.



was admitted into the National Hospital for the Paralysed and Epileptic under my care on July 21st, 1890. (Dr. Taylor, Dr. Rivers, and Dr. Bowman.)

*Previous history.*—About five years ago she had much pain in the back and chest, and weakness in the legs. She was quite unable to walk; no incontinence; retention at times for twenty-four hours. She was admitted into one of the London hospitals, but came out rather worse than when she went in. Went to Hastings and improved; in seven or eight months she was able to walk again. She was admitted to the Brompton Hospital on account of a chest complaint about three years ago; was able to walk while she was there. Has been in various places since. Present condition became established two years ago. She had not been well for some weeks, and had been overworked and subjected to great emotional strain for some days previously. Her legs suddenly gave way beneath her while she was walking. She fell, and has never been able to walk or use her legs since. Has never had any trouble with her urine further than the tendency to retention already mentioned. Pain in back and in chest; never pain in legs. She has never been strong. She has suffered a good deal from cough and expectoration; has brought up blood several times, but not lately. Catamenia irregular; sometimes sees nothing for five months. Has never had fits of any kind.

*Family history.*—Father died of kidney and heart disease; mother alive and healthy; has one brother and six sisters, two of latter not strong, one suffering from chest, one from back.

*Present condition.*—Patient is a somewhat delicate-looking woman, complaining of loss of power in the legs. Slight drooping of right upper lip. Tongue goes a little to the right on protrusion. Palate moves normally. Has lost her voice at times completely; for about a month being the longest time. There is blunting of sensibility to touches over the face, both light and painful; light touches, in fact, are not perceived at all.

*Eyes.*—Pupils equal, reacting to light and accommodation. No ocular paralysis and no nystagmus. Ophthalmoscopic examination: Discs red, edges a little ill-defined, and veins full. No distinct evidence of optic neuritis.

*Arms.*—All movements are carried out fairly well. Sensibility is very much blunted both for light and painful touches; light touches are not perceived at all. Sense of position of the arms seems to be fairly good; but she is unable to tell correctly the position (whether one of flexion or of extension) of the hands and fingers. Elbow- and wrist-jerks active and equal.



**Lower Extremities.**—Absolutely no power of movement in the lower extremities, except by movement of the trunk. Sensibility to light touches is absent, and a pin can be pushed into the skin until it sticks without producing any painful impression. It is usually felt as a touch. Sense of position as regards the legs is absent, except that she can tell when they are crossed one over the other. Knee-jerks present and active. A slight tendency to ankle-clonus exists on each side; plantar reflexes not elicited. Trunk: Sensibility blunted everywhere to ordinary and painful impressions. Epigastric and abdominal reflexes not elicited.

**Heart:** Nothing unnatural. **Lungs:** At apex in left subclavicular region some flattening and deficient expansion. Breath sounds are rough, but no râles exist; vocal resonance is increased, but no pectoriloquy. Abdomen presents nothing unnatural; no tenderness in ovarian regions. Urine acid; no albumen and no sugar.

She was ordered Ferri Ammon. Cit. gr. v., Tinct. Valerian  $\mathfrak{mxxx}$ ., Aq. ad  $\mathfrak{zj}$ ., three times a day; also faradisation and the wire brush to lower extremities daily.

Aug. 9.—Sense of smell found to be diminished on right side. Great retraction of both visual fields, the area for red being especially retracted on the right side. Hearing also slightly diminished on right side. No sense of taste over anterior two-thirds of tongue, though it seems natural over posterior third. The tongue is now protruded very much to the right. She complains of tenderness over fifth, sixth, and seventh cervical spines.

Aug. 15.—The right side of the tongue acts normally to faradic and galvanic currents. The reaction of the anterior tibial group is also normal. Ordered one drachm of cod-liver oil three times a day.

Sept. 1.—Remains in the same condition as regards loss of power in legs. Feels wire brush, and the strong application thereof causes her to move the legs slightly. Has been sick for the last two or three days after almost everything, even when put on half an ounce of milk every hour and nothing else. Passing the nose-tube and feeding through it had no effect in stopping the sickness. Optic discs examined, and found to be in the same condition as on admission. The mixture she had been taking was suspended on Aug. 25th.

Sept. 5.—All feeding by mouth stopped to-day, as sickness continued. Ordered a beef suppository, and an enema with two eggs, alternately, every three hours.

Sept. 8.—No sickness since suspension of ordinary diet. Optic discs remain as before.



Sept. 25.—Since last note the patient has been fed on nutrient enemata and suppositories. She was on one or two occasions during this time tried with a little milk or bread-and-butter, but the effect always was to renew the sickness. To-day she is much better, and enemata, etc., are replaced by milk, beef-tea, and custard by the mouth.

Oct. 1.—Has not been sick at all since last note was made. Is taking food well. Ordered massage to legs, and three sulphur baths a week.

Oct. 6.—The sickness has recommenced; patient vomits after everything she takes. Rectal feeding resumed, and sulphur baths suspended.

Oct. 12.—Food tried by mouth yesterday; sickness still continues. The nutrient enemata have been retained.

Oct. 17.—Fed by rectum since last note; feels less sick to-day; has taken some milk and soda without vomiting.

Oct. 21.—Has been taking some milk and soda by mouth; but is still fed partly by suppositories. Tongue still put out strongly to right. Legs powerless and almost completely anæsthetic.

Oct. 24.—Has been more sick, but has kept down some food. Has returned enemata occasionally.

Oct. 27.—Has been fed entirely by rectum since last note. Has not been retaining the enemata, but retains the suppositories.

Nov. 21.—Began again to take some milk by the mouth regularly; at first only two ounces at a time.

Nov. 26.—Taking more milk by mouth and is having enemata less frequently.

Dec. 8.—Is now taking sufficient food by mouth, and rectal feeding is to be suspended.

Dec. 19.—Treatment of legs by wire brush recommenced.

March 20, 1891.—During the last three months there has been no return of sickness. There has been slight improvement in the power of moving the legs as she lies in bed, especially under the stimulus of the wire brush, which is also felt more distinctly.

April 9.—Very slight improvement in legs continues. Tongue still protruded strongly to right, and when in this position there is constant flickering of the tongue muscles, and the right side has the appearance of being wasted, but both sides respond equally well to faradic and galvanic currents.

June 19.—Ordered again to have a sulphur bath three times a week, also massage to the lower extremities. To take one drachm of Easton's syrup three times a day.



June 26.—Patient has been taking food badly again, with occasional sickness, especially when food has been pressed upon her.

July 2.—Refusing food almost entirely; fed through nasal tube, but was sick afterwards.

July 4.—Taking food better.

July 14.—Since last note she has been taking food much better. Very slight, if any, improvement in legs lately; draws them up fairly quickly in bed but cannot lift them off the bed, and does not draw them up without first turning the limb on to its outer side. Both limbs are perfectly flaccid, and lie extended with dropped ankles. The limbs are wasted generally, but there is no definite or localised muscular atrophy. Knee-jerks active; no ankle-clonus obtained or plantar reflex. Cannot sit up in bed; has to be supported. No prominence in any part of spine; general tenderness over lumbar and sacral regions. Arms.—All movements performed feebly. Dynamometer: Right, 5: left, 5. Wrist- and elbow-jerks active. Tongue is still strongly protruded to the right; there is, when protruded, the same flickering on both sides, and the same distinct appearance of wasting on the right side, but the two halves respond equally well to a weak faradic current. Sensation.—Light touches felt imperfectly all over the body, but not felt at all over the legs. In the legs there is still loss of all modes of sensibility, superficial and deep, almost complete. She can, however, feel the wire brush slightly, and more than when it was first used. There is no abrupt demarcation above for this complete loss of sensibility—it gradually diminishes over the lower part of the trunk. Conjunctivæ sensitive. All over the body (including face and scalp but excepting the legs) pricks are only felt as touches; patient is unable to distinguish between the point of a pin and the tip of a finger. Muscular sense: This is completely absent in the legs. The patient is quite unable to tell in what position her lower limbs are when not looking at them, and when allowed to look she is often surprised to find them in unexpected positions. This absence of sense of position applies to each part of the limb—*i.e.*, toes, ankles, etc., as well as to the limb as a whole. In the arms muscular sense is only impaired; the patient can tell approximately in what position the limb is placed, but not accurately; knows usually whether the limb is bent or straight, though occasionally is not quite sure. Still taking Easton's syrup thrice a day; is having sulphur baths, massage and passive movements, as well as daily applications of the wire brush to the lower extremities. Inability to sit up prevents recourse to statical electricity.

Oct. 21.—There has been but little change. Sensibility to touch



and pain is distinctly affected on the face, and all over the head and back of neck. Electrical treatment, massage and baths as before.

Nov. 25.—Statical electricity and wire brush on alternate days.

Feb. 3, 1892.—Has continued in much the same condition—drawing up legs only a little more actively. Early in January she had a severe attack of influenza with bronchitis, and was ill with it for three weeks. She is not now as well as she was previous to this attack. She moves her legs less actively, and takes her food badly. Electrical treatment and baths had to be suspended for four weeks. Massage, wire brush, and statical electricity now resumed.

March 14.—Ordered faradisation again to legs and back; also Ol. Morr. ʒj. bis die; and Liq. Strych. ʒiv., Liq. Arsenical. ʒiij., Ferri et Ammon. Cit. gr. iv., Aq. ad ʒj. ter die.

June 21.—Her condition has slowly improved since last note. She still cannot raise body to sitting posture, or sit up unsupported when so raised. But when dressed she can now sit up in an arm-chair pretty well, and has been doing so daily for some weeks. She can also stand when supported on each side, and attempts to walk by sliding her feet forward. Is much hindered in this by feet partially remaining in a position of talipes equinus. Can now move arms feebly at all joints; can sew, knit, etc. Legs flaccid; feet in position of equinus. The right can be passively flexed almost to a right angle; the left cannot, and the attempt causes pain in the calf. Can flex right foot partly, and toes fairly well; on left the corresponding movements are less. Can draw up both legs to an angle of about 150° at knee. Can just raise the right leg off the bed; not so the left. Knee-jerks still exaggerated. Ankle-clonus now present on both sides. Plantar reflexes absent. Pharyngeal reflex also absent; no retching when palate and pharynx are touched in any part. Tongue still protruded strongly to right, and with the same flickering tremors.

Still complains of pain over the lumbar spine, but there seems to be no tenderness there or between the shoulders. Both special and common sensibility has distinctly improved, though the latter is still more or less defective in most parts of the body. Muscular sense in arms is good; and in the legs it is now only somewhat impaired. The catamenia were at first very irregular, but during the last fifteen months they have been regular and painless, though rather profuse. The massage and electrical treatment have been steadily continued. The legs are much wasted, and the muscles very flabby.

July 6.—Ordered a daily subcutaneous injection of Liq. Strychniæ (B.P.) of ʒiij.; subsequently increased to ʒiv.



July 27.—She has made very distinct progress during the last month. She walks very much better with the go-cart, moving each foot fairly well (though slowly) forward, and getting each of them flat on the ground. Her arms are also distinctly stronger; grip R. 13; L. 4. The back muscles are likewise much stronger, so that she can now stand fairly erect, instead of leaning much forward, over the go-cart. Is to be discharged shortly, and to go to the Finchley Convalescent Home.

This case, it will be seen, has been one of considerable duration, having lasted continuously for two years before admission, and having been preceded by a somewhat similar attack about five years ago. The present attack is said to have commenced abruptly (as in CASE 6), the patient's legs suddenly giving way while she was walking. She fell, and has never been able to use her legs since. The blunting of sensibility over the arms and face, as well as the affection of the special senses (this being more marked on the right side), together with the very much more marked loss of sensibility in the lower extremities, all tend to show that we have here to do with an irregular, incomplete, double hemianæsthesia of cerebral type; and that the complete motor paralysis was also of cerebral origin seemed probable, though it was not clearly shown, by the completely flaccid type of the paralysis, coupled with the fact that there was no definite wasting of the leg muscles, and that they responded well to medium faradic currents. These characters are commonly met with in such cases, but they may occur also, as we shall see, in cases of functional paralysis of spinal origin.

Harmonious with my own view as to the causation of the paralysis in this case, though not of course proving it here, there is the fact of the complete loss of muscular sense in the paralysed limbs. I say not proving it, because it might be argued that the loss of muscular sense was, as in other simple cases of hemianæsthesia, due to functional defect in the region of the posterior third of the internal capsule. In reply to this, however, it may be said that functional defects so situated, when existing alone, are not productive of paralysis; that here there was paralysis; and that therefore it may fairly be presumed that the same kind of defect had also involved the kinæsthetic centres for the lower limbs, seeing that other



evidence has shown this to be adequate to produce such a paralysis. In the upper extremities there was only a very slight hemianæsthetic condition, with diminution of muscular sense, in the fingers, but without paralysis, so that in all probability these less severe sensory defects were due merely to slight functional disease in the sensory region of the internal capsule.

Charcot has recently recorded a case<sup>1</sup> in which there was a very similar distribution of sensory and motor paralysis occurring in a man twenty-nine years of age who had been knocked down by a passing vehicle. He was unconscious for five or six days afterwards ; then partially recovered and left the hospital to which he was first taken. Two weeks after the accident he had a sort of fit, which left him in a condition of deep stupor for a week ; after this the motor weakness of the lower extremities showed itself, slight at first and only gradually becoming complete. Here the loss of sensibility, including marked loss of muscular sense, was confined to the lower extremities (the limitation being abrupt, and corresponding closely with the upper border of the pelvis) ; and, in addition to other characteristics, there were such affections of the special senses as are to be met with frequently in functional cases of cerebral hemianæsthesia. Further, special evidence is adduced by Charcot of a valuable kind, tending to prove not only that the paralysis was of cerebral origin, but that it was clearly of a functional type.

He points out that in hemianæsthetic hysterical persons he has been able to produce by hypnotism a precisely similar flaccid paralysis of the lower extremities, associated with loss of muscular sense, and with the upper limit of anæsthesia similarly situated.

The functional nature of the malady in the case of this man who had been knocked down was also clearly demonstrated by the fact that during a very severe convulsive seizure that occurred between nine and ten months after the onset of the paralysis the patient suddenly recovered the use of his limbs. Charcot says :<sup>2</sup> " During the attack, all in a moment, it was noticed that the lower extremities were being thrown about, and the feet struck the bar at the end of the bed with so

<sup>1</sup> *Loc. cit.*, p. 374.

<sup>2</sup> *Loc. cit.*, p. 377.



much force that it became displaced. The attack terminated ; the patient got up from his bed and commenced to walk, at first with a certain amount of hesitation, supporting himself along the wall and by means of surrounding objects, but at the end of a few hours his powers of walking became absolutely normal."

In my own case a most tedious and protracted treatment has been necessary, because on several occasions, directly a more vigorous treatment had been initiated, obstinate vomiting set in, which persisted more or less for several weeks. Later on her recovery was greatly retarded by an attack of influenza. Then, too, not to speak of the earlier attack, it must not be forgotten that the complete paralysis of this patient had persisted for two years previous to her admission to the hospital. She became able to walk again, in fact, after the lower extremities had been perfectly useless for a period of nearly four years.

There is one other point in connection with this case to which reference should be made, and that is the remarkable deviation of the tongue to the right when protruded, together with its tremors and appearance of unilateral wasting. This condition, apparently only slightly marked on admission, soon developed, and has persisted without change during the last eight or nine months. None of the medical officers of the hospital have ever seen any variation in this sign when the tongue has been protruded. There is the closest simulation here of unilateral paralysis with atrophy ; yet when the tongue is lying in the mouth at rest it seems symmetrical, and both sides have been found to act equally to moderate faradic currents. Curiously enough, in Charcot's case above referred to there was a spasm with tremors affecting the muscles at the left angle of the mouth. In reference to this he says :<sup>1</sup> "This was at first thought to be due to paralysis of the right inferior facial. But on further examination it is recognised to be due to a spasm of the muscles on the left side of the face, as is evident by the tremors, sometimes slow, sometimes fast, in the labial commissure of that side. When the tongue is protruded there is no deviation."

<sup>1</sup> *Loc. cit.*, p. 377.



Thus far we have considered as examples of this mixed type of localisation (where functional defects exist in both the sensory region of the internal capsule and in the Rolandic area of the cortex) cases in which the paralysis has had a hemiplegic distribution, and also cases in which it has been of paraplegic type. But, in addition, we may have to do with *monoplegias*, either *brachial* or *crural*. I have not myself any new cases of this sort to bring forward on the present occasion, but according to my interpretation three very typical cases of this kind have been very fully described by Charcot, and the facts in regard to them are so important as to deserve attentive consideration. They tend, indeed, to throw an important light both upon the regional and upon the pathological diagnosis.

In all three cases the condition developed in young men at variable intervals after blows or falls upon the shoulder on the side affected. Thus in one case<sup>1</sup> the man, Mouil—, met with a buffer accident in which his left shoulder was rather badly squeezed. He fainted, and was insensible for twenty minutes. On awaking, he found himself unable to move the arm at the shoulder or at the elbow, and after from three to four days he had also lost the power of moving either the wrist or the fingers.

In another case<sup>2</sup> the young man, Pin—, fell from a height of about seven feet on to his left shoulder; at first the movements of the corresponding arm were not much interfered with, notwithstanding the bruising of the shoulder. But on the third day after the accident the patient noticed a feebleness of the limb, and the doctor who was consulted discovered a “paresis of all the movements of the left arm, with anæsthesia of the limb.” Eleven days after the accident, “the patient was still able, though sometimes very incompletely, to flex the hand upon the forearm, and the latter upon the arm, but all movements of the shoulder were impossible.” But twenty-two days after the accident the paralysis had become absolutely complete in the affected limb.

In the third case<sup>3</sup> the man Porcz— was thrown out of a vehicle, on to the back part of his right shoulder. There was no paralysis till the sixth day after the accident, when, “after

<sup>1</sup> *Loc. cit.*, p. 389.

<sup>2</sup> *Loc. cit.*, pp. 352 and 284.

<sup>3</sup> *Loc. cit.*, p. 263.



a restless night, he found on awaking that the right superior extremity was flaccid, hanging motionless, and incapable of all movement with the exception of the fingers of the hand, which he was still able to move a little." There was no loss of consciousness at the time of the accident in this case.

The above facts show that the development of the paralysis is often gradual both in depth and in range, and that it may set in some days after the accident which acts as its determining cause.

The characters of the developed paralysis were similar in all three cases ; the description given by Charcot<sup>1</sup> of the established condition in the case of Pin— may therefore be quoted as holding good for all. It is in these terms :—"The motor paralysis of the left extremity is absolutely complete—it hangs flaccid and inert beside the body. There is no trace of voluntary movement or of contracture. The muscular masses have retained their normal volume and consistence, and their electric reactions, faradic and galvanic, are in no way modified. The tendon-reflexes of the elbow and forearm are slightly augmented. Complete cutaneous anæsthesia to contact, cold, pricking, and the most intense faradisation throughout the whole extent of the limb—hand, forearm, arm, and shoulder. In respect of the trunk the anæsthesia is limited by a circular line passing almost vertically beside the armpit and subclavicular space in front, and the external third of the scapular region behind. The insensibility extends in an equal degree to the deep-seated parts. The muscles and the nervous trunks themselves may be strongly faradised, the articular ligaments may be forcibly twisted, and diverse movements of the joints, torsion, etc., may be performed without the least consciousness on the part of the patient. The ideas attaching to the muscular sense have equally disappeared. The patient is unable to determine even approximately the attitude in which diverse segments of the limb may be placed, the position they occupy in space, or the direction and nature of the movements to which they have been subjected. . . . Apart from the left superior extremity, there does not exist on this side any modification of motor power, either in the face or in the inferior extremity ; but in these, and over

<sup>1</sup> *Loc. cit.*, p. 254.



the left half of the trunk, the analgesia discovered during the patient's stay in the Hôtel Dieu still exists. Furthermore, we discover by the usual methods that the senses of hearing, smell, and taste are much blunted on the left side." There was also considerable contraction of the visual field in this case on the left side only (the circle of the red, moreover, being outside that of the blue); but in the others there was contraction of the visual fields on both sides.<sup>1</sup>

In one of these cases (namely, in that of Pin——) other characters of great diagnostic and prognostic importance were discovered. Hystero-genetic zones were discovered beneath the left mamma and in other regions, and the irritation of one of these determined a most typical and severe attack of hystero-epilepsy. Many other attacks followed during subsequent days, but in these as well as on the first attack "the left superior extremity took no part in the convulsions; it remained flaccid and perfectly inert." On the tenth day, however, there occurred another fit, "during which the left arm was agitated. On awakening, the patient found to his great astonishment that he was able voluntarily to move the various segments of the limb, of which he had not had the use for a single instant during the long period of ten months. The motor paralysis was not completely cured, without doubt, for there remained a certain degree of paresis, but it was considerably improved."

The fact of the recovery of power in this way, of course, incontestably shows the purely functional nature of the malady in this case, and affords at the same time evidence favouring the view that the functional defect was due to some spasm of vessels which was suddenly relaxed during the fit. Such conclusions are also strongly reinforced by the fact that, dealing with hysterical girls already suffering from hemianæsthesia, Charcot has been able, by hypnotic suggestion, suddenly to produce a sensory and motor paralysis of the opposite upper extremity absolutely agreeing in all its characters, so far as this limb is concerned, with that existing in the three cases above referred to in which the paralysis had more slowly followed upon a traumatism. Nay more, he has by the same

<sup>1</sup> As to the alteration in colour vision which is frequently met with in these cases, see Charcot (*loc. cit.*), p. 73.



means been able to paralyse the limb segment by segment, and after a time to unmake the paralysis in the same manner ; thus imitating exactly the various stages by which sometimes the paralytic condition becomes developed in the traumatic cases.<sup>1</sup>

Further, he has shown that another apparent gap separating the traumatic from the hypnotic cases can be bridged over. Thus, it may be said that these two classes of cases differ fundamentally from one another in regard to etiology, inasmuch as in the one class the paralysis is determined by a blow, and in the other mentally or by verbal suggestion. But, in re-hypnotising one of his previous subjects, Charcot showed that this difference apparently so essential can be made to disappear, seeing that all the paralytic phenomena first obtained can be reinitiated not by verbal suggestion, but merely "by a shock applied on the posterior part of the shoulder ; by sharply, yet not very forcibly, striking this region with the palm of the hand." In reference to this observation Charcot adds :—"The result is, you see, not long in appearing. Immediately the patient starts, emits a cry, and being interrogated as to what she feels, she states that she experiences in the whole extent of the extremity a sensation of enervation, of weight and feebleness ; it seems, she says, as if the member struck did not belong to her. And then we find that the paralysis is really established. It attains its maximum at its very outset, and presents all the clinical features with which you are familiar."<sup>2</sup>

One other question remains in reference to these cases, both traumatic and hypnotic, and that is touching the regional diagnosis. As to this I am a little at variance with Charcot.

<sup>1</sup> *Loc. cit.*, pp. 293-304.

<sup>2</sup> In reference to a still remaining difference Charcot makes the following suggestion. He says (*loc. cit.*, p. 305) : "Without doubt the two men were not at the moment of their fall in a hypnotic sleep, nor subsequently, when the paralysis was definitely established. But in this respect it may be inquired whether the mental condition occasioned by the emotion, by the nervous shock experienced at the moment of the accident and for some time after, is not equivalent in a certain measure in subjects predisposed, as Porcz— and Pin—were, to the cerebral condition which is determined in hysterics by hypnotism." See also what he says on p. 335.



His interpretation of these cases of traumatic monoplegia is that there is a functional defect in the Rolandic convolutions in relation with arm movements, on the supposition that they are motor centres ; and that the sensory impairments are to be explained by the supposition that the cortical defect "is not strictly limited to the motor zone, and that it extends behind the median convolutions to the adjacent parts of the parietal lobe." It will have been seen that my view is different.

Regarding the so-called motor centres as really sensory centres of kinæsthetic type, I think we have the functional defect in them, and also in the sensory region of the internal capsule. The evidence that the latter region is affected rests upon the existence in all the traumatic cases (and probably in the hypnotic, though as to this Charcot unfortunately makes no statement) of a slight cerebral hemianæsthesia on the side affected ; and that this is due to a defect in the region indicated, and not in the cortex, seems to be shown by the fact that where sudden recovery has occurred from motor paralysis during a fit, as in the case of Pin——, and also in one of paraplegic type previously referred to (p. 41), the hemianæsthetic defects, both general and special, have been left unaltered. This is scarcely likely to have occurred if both kinds of defect (motor and sensory) had been due to abnormal states in contiguous regions of the cortex.

It would have been interesting to know whether the monoplegias induced by hypnotic suggestion simulated the traumatic cases also in regard to this presence of an imperfect hemianæsthetic condition on the side of the induced paralysis ; but as to this, as I have said above, Charcot is unfortunately silent. If the hemianæsthesia were really absent in this class of cases, so that the hypnotic suggestion induced only an absolute sensory and motor paralysis of one arm, and that the two defects came and went together, then it seems to me that such cases would be extremely difficult of explanation in accordance with any facts, or even views, that have yet been advanced. What is especially remarkable is the double paralysis, sensory and motor, which can be induced, segment by segment, under the influence of hypnotic suggestion, seeing that it is a total loss of sensation that is induced in the parts, and not merely a loss of the muscular sense with slight diminution of other



modes of sensibility, such as I found existing in the case of Rhoda R. (p. 12).

There is another allied point, also, on which more information is needed. Charcot says that, dealing with the same kind of hemianæsthetic hysterical subjects, he can obtain a motor paralysis in a limb "without any perversion of sensibility." He adds: "It suffices to establish this, as I have many times seen, to persuade the subject at the moment when the suggestion is made, that movement alone will be lost, and that the sensibility will remain intact." It would be very important definitely to ascertain in such cases as this whether the muscular sense in particular persisted or not. If it was not lost, and if there was the establishment in these cases of a purely motor paralysis, then such cases would only be explicable, in accordance with my views, on the supposition that the region next about to be considered, and not the cortex itself, was the part in which the functional degradation existed. On the other hand, should it be found that in such cases there is loss of muscular sense, together with some slight defect of other modes of sensibility, there would be a production of my first type of functional paralysis, and this would constitute another striking proof of the truth of the views which I have advanced in regard to the nature of the functions carried on in the Rolandic area of the cortex.

(D) CASES OF PARALYSIS DUE TO DEFECTIVE FUNCTIONAL ACTIVITY IN SOME OF THE OUTGOING FIBRES FROM THE ROLANDIC CONVOLUTIONS.

The known forms of paralysis of functional type that can be referred to this region of the brain are very few. The region itself is of considerable extent, especially downwards; the fibres referred to being those which compose the pyramidal tract. Thus this particular cerebral region is continuous with one that we shall subsequently have to refer to in the spinal cord. I have elsewhere<sup>1</sup> proposed to speak of these fibres, and of all others that connect sensory centres with motor centres, as "internuncial fibres," leaving the term "commisural fibres" for those by which sensory centres are connected

<sup>1</sup> *Brain as an Organ of Mind*, 1880, p. 586.



with one another, or for the fibres which similarly bind together for conjoint activity two motor centres. It is generally admitted, however, that the internuncial fibres in question pursue a long unbroken tract from the Rolandic convolutions downwards, partly to motor nuclei in the pons and bulb, and partly so as to terminate at different successive levels in the great cells of the anterior cornua of the cord. The internuncial fibres which transmit motor incitations from the Rolandic area down to the lumbar centres concerned with the movements of the lower limb pursue, therefore, the longest course of all.

Taking the different groups of fibres—those, for instance, which go to the bulb, those whose destination is the cervical swelling of the cord, or those which go to its lumbar enlargement,—it seems perfectly clear that the same kind of defect of function would in each case result from a lesion situated in any part of their course. If, for instance, an organic lesion or a functional degradation of some kind were to be established in the course of the fibres that transmit incitations to movement from the glosso-kinæsthetic centre in the third frontal convolution to the bulb, a group of symptoms should be produced by a lesion of these fibres just beneath the cortex, in every way similar to that which would be caused by a lesion to the same group of fibres (that is strictly limited to them) just before they reach the articulatory centres in the bulb. And, this being so, of course the same set of symptoms would characterise lesions limited to these particular fibres in any intermediate part of their course through the corona radiata and the internal capsule.

As to paralysis of the limbs due to functional defects occurring in the course of these internuncial fibres we as yet know nothing positive, whether in the way of the production of hemiplegias or of monoplegias. On the other hand, it is well known that organic lesions occur in the course of these fibres with extreme frequency (especially in that portion of their course where they constitute the “internal capsule”), giving rise to different kinds of hemiplegia of varying degrees of severity. All that can be said is that if paralyzes of functional type should occur, due to dynamic defects in this region, we might have (according to the width or area of the functional



defect) the coexistence of more or less facial paralysis with that of the limbs, together perhaps with slight defect in common sensibility. There would in many cases be no loss of muscular sense, and thus these groups of symptoms would be differentiated from those due to disease of the cortex. In both there might be slight increase of the knee-jerks, with or without slight rigidity of the limbs.

As I have elsewhere endeavoured to show,<sup>1</sup> *complete aphemia* is a kind of speech-defect which must be due to structural or functional degradation occurring in the course of the internuncial fibres that pass between the glosso-kinæsthetic centre in the posterior part of the third frontal convolution and the motor centres for articulation situated in the bulb. In this class of cases patients are absolutely dumb—that is, they are voiceless as well as speechless; but they understand everything that is said to them, and can express their thoughts perfectly and with unimpaired facility by means of writing. Their intellectual faculties are, moreover, quite unimpaired.

Aphemia is clearly not a sensory defect—it is not a form of amnesia—because the subjects of it can revive words in all possible modes, as is seen by the fact above mentioned that they are able to think and to express their thoughts with an unimpaired freedom by writing; whereas in aphasia, which is due to disease or non-activity of the glosso-kinæsthetic centre itself, one form of word memory is incapable of revival, the power of thinking is therefore to some extent impaired, and thoughts cannot be expressed either by speech or writing.

Aphemia, in the complete form above referred to, seems to be somewhat rare as a result of structural disease, though a few years ago I recorded what I believe to be a case of this type.<sup>2</sup> On the other hand, Charcot<sup>3</sup> and Cartez have shown that it is by no means uncommon as a functional defect, which the former has fully described under the name of “hysterical mutism.”

They have found that this group of symptoms sometimes exists alone, and at others in association with hemianæsthesia

<sup>1</sup> *On Different Kinds of Aphasia, etc.* (*Brit. Med. Jour.*, Nov. 5th, 1887).

<sup>2</sup> *Loc. cit.*, Nov. 5th, 1887.

<sup>3</sup> *Lectures*, vol. iii. (Translation of Sydenham Society), 1889, pp. 360 and 410.



and other hysterical stigmata. The onset is often sudden after a fright or some other powerful emotion ; or it may follow a hysterical seizure of some kind. The duration of the malady is very variable ; it may be for some hours only, or the dumbness may last for weeks, months, or even years. Complete recovery, too, is often quite abrupt, sometimes after some strong emotion ; whilst Dr. Ernest Jacob has recorded<sup>1</sup> two interesting cases in which such an aphemic condition was cured by putting the patient under the influence of ether.

In one of these cases the man had not spoken a word for five years, but having accidentally dislocated his shoulder ether was administered to facilitate its reduction, and Dr. Jacob says, "on recovering from the narcotism he began to speak clearly and volubly, evidently much pleased at recovering his power of speech, and determined to make up for lost time." The other patient, also a man, had been dumb for only five days ; but, recalling the effect of the ether in the previous case, Dr. Jacob this time purposely had recourse to it as a remedial agent, with the following result : "After he had taken one or two breaths, the inhaler was removed, and he articulated 'Yes' in answer to a question ; and after recovery from the narcotism could talk freely. He remained an out-patient for a few weeks, but there was no return of the dumbness."

We must not, however, conclude that all cases of aphemia, in which the duration of the condition is brief and the recovery more or less abrupt, are necessarily of functional type in the ordinary acceptation of the word. Some of them may, I think, be more fairly attributed to the existence of a temporary thrombosis, involving some of the vessels supplying the brain region in question. In illustration of this I would quote the following case.

**CASE 8.**—Henry C——, aged forty-four, a carpenter, was admitted into University College Hospital under my care on May 29th, 1890, suffering from complete loss of speech, and some difficulty in swallowing. (L. Williams, M.B.)

*History* : The patient had been at work on the previous day from 6 A.M. to 12 P.M., so that when he went to bed he was greatly fatigued. About 1.30 A.M. his dog barked ; he got out of bed to

<sup>1</sup> *Brit. Med. Journal*, Sept. 13th, 1890.



speaking to it, and found he was unable to do so. He then took a paper and pencil, attracted the attention of his wife, and wrote that he was unable to speak. He was brought to the hospital in the morning at 9 o'clock, when he was found to be still suffering from complete aphemia, though he could write fairly well, merely omitting a letter now and then.

After admission as an in-patient, he fell into a drowsy state, and in the afternoon he went to sleep, and did not awake till 6.30 p.m. He then found himself trembling all over, but his power of speaking had returned.

In regard to his previous health, the patient says that at the age of sixteen he contracted syphilis, and was treated for it. About one week before the present attack he had had a sudden feeling of giddiness while at work. He had been much exposed to wet and cold; he had always had plenty of good food, but had been a rather immoderate drinker—of beer principally. He had not, however, been drinking at all to excess on the day on which he overworked himself or for several days previously.

*Present state* (taken May 30th): He has some dilated venules over the face, but is a fairly healthy-looking man. The arteries at the wrist and elsewhere are slightly thicker than natural. Nothing abnormal was detected in regard to the thoracic or abdominal organs. Temperature  $99.2^{\circ}$  (it was  $99.4^{\circ}$  a few hours after admission). Pulse 96; respiration 18. He has had no headache for the last twenty-four hours. There is now no difficulty in speaking, and no thickness of speech. All the movements of the tongue are free and natural. The various reflexes of the limbs and trunk are natural, and no impairment of sensibility can be detected in any part of the body. He walks naturally; his grip is weak—right, 55; left, 45. There is some tremor present in both forearms, most marked on the left side. These tremors are exaggerated when he picks up objects. There are no tremors in the legs whilst he lies in bed, but on commencing to walk his legs begin to tremble.

June 2nd: He left the hospital to-day, well. His temperature was normal, as it had been for the last two days. All the tremor in his arms had disappeared, and there was not the slightest difficulty or hesitation about his speech. He took no medicines while in the hospital, except *Mist. Gent. c. Sodæ*,  $\text{ʒi}$  ter die, and an aperient draught.

It seems quite possible that there may have been some thickening of cerebral arteries here, which, together with a feeble action of the heart induced by fatigue, determined a



slight thrombosis, and that this condition after a short time became resolved. A similar possibility of speedy recovery exists also in cases where small cerebral arteries have been temporarily blocked by emboli. And of such results some interesting examples have recently been recorded by Dr. Bristowe,<sup>1</sup> in an article entitled, "Speedy Recovery from the Effects of Cerebral Embolism."

On the other hand, it must not be forgotten that in some of the functional cases belonging to the category now under consideration, recovery has taken place rather slowly and gradually; the first imperfect articulations being also of a stammering character. In this respect they simulate cases due to organic disease.

I may repeat, then, my belief that this form of speech defect may be produced by damage to efferent internuncial fibres in any part of their course from the left glosso-kinæsthetic centre to the articulatory centres in the bulb. The mental power in such patients is as clear and unaltered, and the power of writing just as perfectly preserved, as it may be in cases of bulbar disease where the motor articulatory centres themselves are the seat of lesion, but where the clinical symptoms are differentiated by the fact of the co-existence of difficulties in deglutition. I would also urge that the hysterical or functional cases cannot be caused by dynamic defects in the brain regions usually implicated in hysteria (that is, either afferent fibres or cortical centres), because no lesions of such brain regions would suffice for the production of the uncomplicated group of aphemic symptoms; such a state can, I believe, only be accounted for by a defect, either functional or structural, in the course of the efferent fibres from the left glosso-kinæsthetic centre.

As to whether in any given case of complete aphemia the malady is due to a structural or to a merely functional defect, we must be guided in part by the previous history and present state of the patient. A history of hysterical convulsions or the presence of a hemianæsthesia would greatly favour the view that the malady was of purely functional type. In the absence of these guiding signs, the determination may prove very difficult, and give rise to much difference of opinion even

<sup>1</sup> *Brain*, April 1888, p. 78.



between experts. In cases of this kind the aid that may be afforded by an inhalation of ether must not be forgotten.

A few words require to be said concerning mere voicelessness or *aphonia*. This is not to be confounded with *aphemia*, though it generally, in fact, constitutes a component of the *aphemic* state. A patient suffering from mere *aphonia* can speak in a whisper, simply because whispering does not necessitate the action of the adductor muscles of the larynx, and in *aphonia* it is these adductor muscles that are paralysed—that is, they cannot be made to move so as to take part in ordinary acts of articulation, though they are still capable of being called into action reflexly during the act of coughing. It is therefore the voluntary activity of the adductor muscles of the larynx that becomes paralysed in *aphonia*, under the influence of various predisposing causes. It occurs, apart from inflammatory conditions of the larynx, principally in low states of the system under the influence of debility, or from previous over-exertion of the voice, or as one of the results of hysteria.

It has been thoroughly ascertained by Semon and Horsley<sup>1</sup> that the movements of the larynx, and principally those of adduction, are represented in the cerebral cortex; the chief focus for the instigation of these movements being found at the base of the ascending frontal convolution, just where it becomes continuous with the posterior extremity of the third frontal. From this cortical region, efferent internuncial fibres have been traced through the corona radiata and the internal capsule to the bulbar centres. As to the part of this mechanism which is at fault in *aphonia*, whether the cortical centre or the internuncial fibres, there seem to be no facts at present in our possession to enable us to decide. The condition is, however, in the great majority of cases, clearly due to a mere functional defect.

<sup>1</sup> *Philos. Trans.*, vol. clxxxi., 1890, p. 187.



## CASES OF FUNCTIONAL PARALYSIS OF SPINAL TYPE.

As I have already stated, a great deal of obscurity exists in regard to this part of our inquiry. The whole subject of the classification of functional paralyses is still in a very vague and ill-defined condition. The principal effort hitherto made seems to have been expended in arriving at the often difficult preliminary conclusion as to whether in the patient before us we have in reality to do with a case of hysterical or functional paralysis or not. The recognition, rightly or wrongly, of the case as a hysterical affection has seemed, to most even of our best observers, to be a sufficient solution of the diagnostic problem ; so that chiefly we find given more or less disconnected indications (apart from the recognition of hysterical stigmata) by the presence or absence of which we are to decide whether we have to do with a case of paralysis of functional type, and therefore in all probability curable (for that is, of course, the reason of the vast interest attaching to this problem), or with one due to some irremediable organic cause.

The signs of a functional paralysis as contrasted with one due to organic disease are indeed commonly spoken of as though the former condition constituted a kind of entity, one and indivisible, instead of a whole series of states with varying characters, according as this or that portion of the brain or spinal cord may happen to be the seat of a functional disability. Some appear to think (or their language seems to imply) that all cases of paralysis not due to a structural cause must be of a hysterical order ; and as they believe hysteria to be due to a perverted activity of the brain, it perhaps never occurs to them to consider whether some of the cases of functional paralysis coming before them may not have their origin in a depressed or perverted activity in some portion of the spinal cord. For



one or other of these reasons it happens that up to the present time almost nothing has been said upon this subject ; so that no rules of any kind are laid down in our text-books to help us in distinguishing spinal from cerebral cases of functional paralysis.

I am free to confess that this subject has only comparatively recently engaged my own attention, and that what follows is to be considered as a tentative introduction to a department of medicine in which, perhaps, more advance ought to have been made, and to which I hope it is only necessary to call the attention of observers in order speedily to bring about a distinct increase in our knowledge. This subject has been in a measure forced upon me, during the last three or four years more especially, owing to the fact of my having had under my care several cases of paralysis, the exact nature of which has proved a very difficult problem to resolve. Though they appeared to be of functional type, I could not satisfy myself that there was any adequate reason why they should be regarded as belonging to the hysterical category of functional paralysis.

From the point of view of the production of a functional motor paralysis of spinal origin we may have two distinct types of disease which deserve to be separately considered—namely, (*a*) those of a spastic, and (*b*) those of a flaccid type. The cases that we are now about to consider mostly belong to one or other of these categories, though occasionally cases present themselves that are partly of spastic and partly of flaccid type. It may be said at once that these two types correspond with a perverted or depressed activity in one or other of the two definite regions of the cord which have to do with the manifestation of voluntary movements ; the spastic type, for instance, corresponds with a diminished or perverted activity in some part of the course of the pyramidal system of fibres ; while the flaccid type would correspond with a diminished activity in some of the groups of great ganglion cells situated in the anterior cornua.

Some instances of what I regard as examples of these two types of functional paralysis of spinal origin will now be cited.



(A) CASES OF THE SPASTIC TYPE, DUE TO FUNCTIONAL PERVERSION OR DEFECT IN THE PYRAMIDAL SYSTEM OF FIBRES IN THE SPINAL CORD.

When speaking of the last type of the cerebral cases—viz., the forms of paralysis due to defect in the internuncial fibres starting from the kinæsthetic centres in the Rolandic convolutions—we had to consider the effect of lowered functional activity occurring in the upper or cerebral part of the “pyramidal system,” the fibres of which (so far as they are concerned with movements of the limbs and trunk) are continued without any break into the opposite anterior-cornual grey matter of different segments of the spinal cord. It must be recognised that in regard to these fibres, as I have already said and so far as we have any positive knowledge, no appreciable differences would accrue from their implication in different parts of this course—that is, that the same result to limbs or trunk should be produced by the affection of corresponding constituents of the pyramidal system, whether the alteration in their functional activity is brought about in the cerebral or in the spinal part of their course.

Although probable, this must not, however, be taken as absolutely established. It is, in short, just possible that these fibres may, as they pass through the pons Varolii, be in some way brought under the influence of the cerebellum through its middle peduncles ; so that, as a matter of fact, injury to a given set of the pyramidal fibres in the spinal part of their course may cause somewhat different results from what would have been produced by a similar degree of damage to the same set of fibres above the level of the pons. One kind of difference which clinical facts seem to suggest as possible is that there should be, as a result of damage to the pyramidal tract in the spinal part of its course, a greater intensity in the spastic symptoms—that is, more rigidity and a greater exaggeration in the deep reflexes. But even if such a difference should exist in the results accruing from a lesion or functional degradation of the pyramidal system of fibres according as they may be involved in the cerebral or in the spinal part of their course, there is no reason for thinking that the results would



not, other things being equal, prove similar in kind for injury to the pyramidal fibres at different parts of their course through the spinal cord itself.

To a slight or early stage of a functional defect in some part of the pyramidal system Dr. Hughes Bennett has already called attention in a valuable communication to the Neurological Society. "In this condition," he says,<sup>1</sup> "the only complaint made by the patient is of motor weakness, and the only objective sign discoverable by the physician is excessive muscular contraction on percussion." The most ordinary seat of the affection is the lower extremities. It usually begins in one leg, and sometimes, though rarely, remains limited thereto.

Coexisting with motor weakness of varying degrees, we find also, in different cases, variations in intensity of the objective phenomena. "The response of the muscle to percussion is increased, and the tendon phenomena are exaggerated. Every degree of exalted action may exist, from the slightest elevation impossible to differentiate from health, to the most extreme demonstrations of muscular excitability. In advanced cases trepidations and cloni may be produced in various situations, especially at the ankle and knee. These, however, are usually absent or only imperfectly developed."<sup>2</sup> After variable periods such a condition may entirely subside, so that the patient completely recovers; in others a comparatively stationary condition has been maintained for many years.

These signs and symptoms are clearly similar to those which constitute the first stage of a spastic paralysis due to a primary sclerosis of the lateral columns of the cord. But in these cases of "*hypertonic paresis*," as Dr. Bennett proposes to term the affection, the symptoms do not seem to advance in the limb or limbs first affected beyond a certain degree of severity, although in the worst cases the morbid condition may spread from one limb to the other, till at last the entire body is affected. Dr. Bennett says,<sup>3</sup> "I have myself never seen a case such as has just been described afterwards pass into one of typical spastic paralysis with its characteristic rigidity of

<sup>1</sup> *Brain*, 1888, p. 292.

<sup>2</sup> *Loc. cit.*, p. 291.

<sup>3</sup> *Loc. cit.*, p. 296.



muscle," and this applies, he says, even to cases which he has had an opportunity of watching for five or six years. Nevertheless, this is a moot point which must still be considered to remain open.

As to the seat of the functional change, also, in this class of cases nothing definite is known: such a combination of symptoms might be produced by a diminution in functional activity in any part of the course of the pyramidal system of fibres; or, on the other hand, it might possibly be due, as Dr. Bennett is rather inclined to think, to some unduly irritable condition of the anterior cornual cells in which such pyramidal fibres terminate. This latter explanation seems to me less probable, because it does not so adequately account for one-half of the symptoms—viz., the paresis—as it does for the other—the condition of hypertonicity.

A moderately well-marked condition of this kind is fairly well exemplified by the following case.

CASE 9.—Miss Sarah Landon, aged 33, single, formerly a governess, was sent to me by Dr. L. B. Diplock of Chiswick, and was subsequently admitted under my care, as a "Contributing Patient," to the National Hospital for the Paralysed and Epileptic on Nov. 4th, 1891. (Dr. Rivers.)

*Previous history.*—There is some history of phthisis both on the father's and on the mother's side, but no definite neurotic history. The patient herself was never very strong, but had no definite illness till five years ago. Has had much family trouble during the last ten years, owing to deaths and money losses. Five years ago, soon after having nursed her mother in her fatal illness, she began to feel weak and languid, and she was generally ill then for two or three months. Her legs have been very weak ever since, but more especially so during the last eighteen months. In walking her legs have been so feeble that they have occasionally given way and she has fallen: this happened twice last week. For the last year she has only been able to walk a very short distance, though she has never been quite unable to walk. She makes no complaint but of this weakness. The catamenia are regular and have always been so.

*Present condition.*—No oscillation of head. Eyes: movements in all directions well-performed. Very slight nystagmoid jerkings, especially on looking to left. Pupils equal, acting to light and accommodation. Optic discs normal. No asymmetry of face.



Tongue protruded straight ; no tremor. Palate acts well on phonation—  
Articulation unimpaired.

Arms.—All movements performed well though rather feebly on both sides. Tips of fingers brought together or to nose without any tremor ; and no tremor on raising glass of water to mouth. Wrist and elbow jerks active and equal. Sensibility to touch and painful impressions normal.

Gait feeble, nothing characteristic. Walks slowly and badly, with feet wide apart. Stands well with eyes closed.

Legs.—These are moved well in bed, but she cannot flex hips or knees against much pressure, especially on the right side. No distinct wasting of either leg. Sensibility in its different modes unaffected. Knee-jerks exaggerated and equal ; ankle clonus slight, equal ; plantar reflexes slight.

Examination of the heart, lungs, and abdominal organs revealed nothing unnatural. Micturition normal. Urine acid, Sp. gr. 1020, no albumen or sugar.

Patient was ordered to rest in bed during the greater part of the day ; to have three electric baths a week ; faradism and massage to the legs daily ; and to take Mist. Quinæ 3j ter die.

Dec. 5.—Patient has improved somewhat since she has been in the hospital ; walks better. Discharged at her own request.

I think there can be little doubt that this was merely a case of functional paresis, and not one of disseminated sclerosis in an early stage. The presence of slight nystagmoid movements of the eye-balls is, however, a point of interest.

I now give the notes of a well-marked case of *spastic paralysis* of an obscure order which I regard as dependent upon a functional perversion and defect in the spinal cord.

CASE 10.—Rachel W——, aged 22, single, was admitted into the National Hospital for the Paralysed and Epileptic under my care on March 25th, 1891. (Dr. Taylor, Dr. Bowman and Dr. F. E. Batten, Cl. Cl.)

*History.*—Four years ago the patient first noticed weakness in her legs, difficulty in stooping, pain in the back, and difficulty in getting upstairs. Twelve months afterwards she went into the Norwich Hospital, and was there fitted with a jacket. She says her spine was “grown out” at this time, and she could feel a lump in her back (pointing to the mid-dorsal region as its site). She could not walk without assistance. She improved while wearing the jacket,



and became able to walk by herself. Her gait was shuffling, and she says that even at this time she was apt to fall when lifting one leg.

She continued fairly well till one year ago; then became worse; her legs grew weaker and "drew up," so that they became permanently flexed, and she was unable to walk. The right leg was the first to become affected in this way. Retention of urine occurred about the same time for two or three days; never suffered from incontinence. The bowels became obstinately confined, and the legs used to "kick about" during the act of defecation. Has also had a tight feeling around the abdomen for nearly a year, and attacks of vomiting lasting two or three days, during which she is sick after everything taken. Three months ago, the legs having become flexed at the hips and knees (the right more than the left), they were placed on splints, and have remained straight since—the splints having been kept on for about six weeks. Retention has been more frequent lately, but has always been relieved by hot flannels; has never had a catheter passed. The girdle pains now come on every few days; formerly they recurred at intervals of some weeks.

*Previous and family history.*—Had rheumatic fever six years ago, and again five years ago; no other illnesses. No neurotic history, but two brothers and one sister died from "consumption"; two brothers alive and well.

*Present state.*—Patient is a fairly healthy-looking girl. Face symmetrical and its movements natural; sensibility normal. Movements of eyes natural, except some slight weakness on lateral movement to the left. Pupils large, equal, react well to light and accommodation. Optic discs natural. Tongue protruded normally, indented, slightly furred. Throat natural. All movements of neck normally performed, though somewhat slowly.

*Arms.*—Movements naturally performed; grasp feeble. Dynamometer: right 8, left 8 (with a very rigid instrument). Sensation natural.

*Back.*—There is no distinct prominence of spines in any region. The sixth and seventh cervical and the first dorsal are slightly more prominent than natural, and the patient complains of pain there on pressure, but with a hot sponge or with percussion over the vertebrae the pain does not seem to be increased. The patient complains of pain all along the vertebral column on pressure.

*Examination of the chest* showed nothing unnatural about the lungs, but revealed the existence of a systolic mitral murmur, together with a slight thrill over the apex.

*Abdomen.*—The patient complains of pain on pressure over the abdomen, most in the right and left hypochondriac regions, but also



over the left ovarian region. The abdominal aorta is easily to be felt pulsating. The tympanic resonance of the stomach is increased. Nothing abnormal is to be felt.

**Legs.**—No marked wasting of muscles. The legs are extended and rigid, the foot being in the position of equinus, the tendo Achillis being tense. The thighs are adducted. The patient is only able to move the legs to a very slight extent, being unable to flex them. On being asked to move the legs the extensors contract, and a very slight movement takes place. There is also slight power of adduction. The patient complains of great tenderness (mostly superficial) over the legs, especially over the back of the thighs and calves of the legs. The legs can be passively flexed to a slight extent, but during flexion and even on raising either leg a clonus of the whole limb takes place. The adductor spasm can be overcome by steady traction. Sensibility to touch seems normal except for the hyperæsthesia on the back of the legs and thighs.

**Reflexes.**—The plantar are present, but not active; the knee-jerks are exaggerated; ankle clonus cannot be produced owing to the spasm and condition of equinus, but a clonus of the foot is easily obtained by the slightest pressure on the sole of the foot. A clonus can be produced in the big toe, and also in the quadriceps extensor of the thigh.

Urine passed naturally since admission except once.

**Electrical reactions:** there is diminished reaction to faradic and galvanic currents, but K C C is greater than A C C.

**Motions** passed naturally, but bowels very constipated. Ordered Ol. Morr. et Vin. Ferri, āā 3 i., ter die.

April 10.—Patient's general condition continues much the same. Careful testing of different modes of sensibility yielded the following results:—Light touches are felt and appreciated correctly everywhere. Heat and cold: the patient is unable to appreciate heat and cold all over the legs and to a variable extent over the abdomen and back; but the appreciation is correct over hands and arms. Painful impressions are not felt as such over the legs, and to a variable level over the chest and abdomen, but are rightly appreciated over the arms and face. Muscular sense could not be properly tested owing to the rigidity of the legs, but patient says she has, with eyes closed, a distinct sense of the existence and position of the legs, though not so perfect as for the arms.<sup>1</sup> There

<sup>1</sup> In cases where the muscular sense is lost or gravely impaired, patients will give a very different answer to such a question. They will say that they have no sensation of the existence of the affected limbs, and are consequently unable to state their position—as in a case of locomotor ataxy recently under my care.



is still the same kind of superficial tenderness of the lower extremities as before.

April 28.—Having suffered for some days from pain after food, the patient yesterday vomited at 7.30 P.M. a considerable quantity of blood mixed with food.  $\mathcal{R}$  Bismuth. subnit., gr. x.; sod. bicarb., gr. x.; sp. chlorof.,  $\mathfrak{m}$  x.; aq.,  $\mathfrak{z}$  i.: ter die.

April 30.—Vomited again at 5.30 yesterday a considerable quantity of blood mixed with food. Has some tenderness at epigastrium.

May 29.—The patient was put on nutrient suppositories on April 30, after which vomiting ceased, and her general condition improved. Milk was given on May 4, but vomiting recurred. On the 12th she was taking milk with Brand's essence, and continued fairly well without sickness till yesterday, when she again vomited. During sleep the legs are not so rigid as when awake.

June 3.—Daily application of wire-brush to lower extremities was ordered.

June 25.—General condition much improved. No vomiting. Condition of legs practically the same as on admission; is still unable to move them, and on attempting to do so clonus is produced. Tenderness of legs on pressure. Sensibility to touch still normal. Complains of pain in the back, worse at night. Right 18, left 20 (with same rigid dynamometer). Marked flushings of face and neck have occurred occasionally since her admission, and still continue. No distinct and persistent tache produced by drawing nail over skin of chest or abdomen. Constant current from about fifteen cells to be run through spine three times a week, and on alternate days she is to have a sulphur bath.

July 31.—Patient is now distinctly better. The rigidity of the legs is notably less; and trepidation is not produced by handling them as before, though ankle-clonus is still very distinct on both sides. She can now move the toes of each foot distinctly and bend the knees slightly, also without causing trepidation. The pain in the head has ceased, and that in the back is rather less.

May 26, 1892.—Went on slowly gaining power, and last October she began to walk again; she gradually improved up to the end of the year, walking about the ward with the aid of a stick, except during the time of her "periods," when she remained in bed. She states that for about six months at these times the flow has been more than it was formerly, and excessive (this the nurse corroborates); and that she has a great deal of pain at these times. The pain is felt in the lower part of the abdomen, the back, and down the outer part of both thighs. These pains are constant, but with exacerbations of a shooting character lasting for a few minutes.



Her ankles and legs below the knees also become slightly swollen at the menstrual periods, so that she has difficulty in getting her shoes on. Owing to this condition of things, apparently, she has not improved much during the present year. She is thrown back at each "period" by the pains and enforced rest. It was after faradisation of the legs and back muscles that she began to walk in October. Subsequently, in November, the wire-brush was employed, and the constant current through the spine was replaced by an electric bath three times a week. She also took Syrup. Ferri Phosph. and Ol. Morrhuæ aa ʒj; ter die. Towards the end of December sulphur baths were substituted for the electric baths. During the menstrual periods she took Bromide of Potassium, and also liquid Extract of Ergot at times.

June 27.—(General investigation of patient's condition by Dr. Bowman.) Head and arms nothing unnatural. Grasp, R. 43, L. 34; with the same rigid instrument that was used in taking her "present state," soon after admission.

Trunk.—Complains of pains across back (lower lumbar and sacral regions) almost constant; worse when up, and much worse during "periods." This pain extends down the front and side of thighs. There is tenderness over these seats of pain, most marked in the thighs. No fibroid growths, or enlargement of the womb, can be made out; but there is ovarian tenderness, most marked on left side. No unnatural prominence in any part of spine.

Heart.—No murmur now detected.

Legs.—Nutrition fair; some slight pitting at ankles; still some tenderness when muscles are grasped. Movements present at all joints, but all rather feeble, especially at ankles; cannot dorsiflex either foot against very moderate pressure. Sensibility good for tactile, thermal, and painful impressions; and the stimuli are also localised correctly.

Reflexes.—Knee-jerks present, not exaggerated; no ankle-clonus; both plantars present and equal.

Electrical reactions: diminished to faradic current; normal to galvanic, K. C. C. being greater than A. C. C.

July 18.—Further slight improvement; walks pretty well with the aid of a stick. Discharged in order to go to the Convalescent Home at Finchley for a month.

This is in many respects an obscure case. It seemed evident on her admission that some years since, when she first began to complain of pain in the back and weakness of the legs, the girl had been treated for spinal caries. On



examination, however, no irregularity of the vertebral spines or other definite evidence of spinal caries could be made out. It seems probable that the form of spastic paralysis from which the patient was then suffering may have been similar to that now existing, and this undoubtedly presented strong alliances with the form of paralysis that commonly goes with Pott's disease.

Still, the fact that there was with these well-developed spastic paralytic symptoms (including considerable impairment of sensibility) no evidence of vertebral or other disease that could cause slow compression of the spinal cord, coupled with certain characters of the paralysis itself (especially the high degree and persistence of the spastic symptoms), made it seem very improbable that it was a case of this nature. Then, again, another fact had to be taken into consideration. The girl had on a previous occasion been so paretic as to have been unable to walk without assistance, and had perfectly recovered for some time previous to the commencement of her present illness, twelve months ago.

Her case was soon deemed, indeed, to be one of functional spastic paralysis; and I take the view that it is of spinal rather than of cerebral type, mainly because of the absence of any distinct impairment of muscular sense in the legs, which, with such an amount of paralysis as exists here, ought to have been marked if the paralysis had been due to a functional defect in the Rolandic convolutions in relation with leg movements in the two hemispheres. I am also influenced by the fact that the special senses were not involved, and that the considerable impairment of sensibility which existed was limited to the lower extremities and to the trunk. Also that the power of accurately localising touches existed, instead of their being referred too high, as in cases where the impaired sensibility is due to defect in the Rolandic convolutions (Horsley). Moreover, during the whole time of her stay in the hospital she had never manifested any undue emotional disturbance, her mental condition has been fairly equable, and there has been no tendency to exaggerate her troubles or disabilities. Her recovery has been very slow and tedious, in great part on account of her weak general health. All active treatment for the paralysis had to be suspended for nearly two months



after the vomiting of blood and constant sickness, and of late, especially, her progress has been greatly retarded by her recurring menstrual troubles, with excessive flow, for which no organic cause, however, could be detected.

It so happens that I have at present under my care, in the same hospital, a young man who was for a time supposed to be suffering from an almost complete transverse softening in the dorsal region of the cord, associated with spinal caries and a marked angular curvature. In this patient, but for the fact that the loss of sensibility was much more marked and the motor paralysis more absolute, the condition of the lower extremities accorded pretty closely with that present in the girl whose case is above recorded. Another very important difference, however, existed in regard to the sphincters and the control over the evacuations. There was no incontinence with the girl, while this was complete in the undoubted case of organic disease.

Still the progress of this latter case has greatly surprised me, and has compelled me to rectify my diagnosis. I formerly took the view that an almost total transverse softening of the spinal cord existed, and that recovery of power in the lower extremities was not to be looked for; whilst now, the nearly complete recovery of this young man has compelled me to believe that we have here to do with a mixed case of structural and of functional disease—that the structural disease was, in fact, nothing like so severe as I had at first anticipated, and that its apparent greater gravity was due to an altogether unlooked-for admixture of serious functional defects.

Such a combination was unlooked for because in my experience anything like it had never previously been met with; nor do I recollect ever to have seen the record of a similar case. The young man was examined with great interest at first by myself and others, because his condition (as regards the rigidity of his legs and the exaggeration of the deep reflexes) was quite the reverse of what I had hitherto met with in cases where there was complete motor and sensory paralysis in the lower extremities.<sup>1</sup> For this reason I felt sure all along that

<sup>1</sup> In such cases, as I have elsewhere pointed out, the limbs are almost invariably flaccid and the deep reflexes are absent. See a paper entitled, "On the



there must be some exceptional condition present ; and, in spite of the apparent complete loss of all power of movement and of all modes of sensibility in the lower extremities, I suspected that the lesion was not a totally transverse one, but that some connecting bridge of grey matter had remained intact.

The notes of this very interesting case of combined organic and functional disease are, therefore, given in detail.

CASE 11.—John P——, aged 20, a draper's assistant, was admitted into the National Hospital for the Paralysed and Epileptic under my care on March 25, 1891. (Dr. Rivers, Dr. Bowman, and Dr. F. E. Batten, Cl. Cl.)

*Previous history.*—There was nothing of significance in his family history or in his own anterior to the present illness. He first felt pain in his back early in 1890 ; by the end of June in that year the pain had extended round the chest, a projection was noticed over the dorsal spine, and his legs had become weak. He saw a doctor and afterwards lay on his back for three months (till September), when he went into the London Hospital. At this time he was not paralysed so much as to be unable to walk ; he was able to walk upstairs when he went into the hospital. There he was kept in bed for fourteen days, when, being "suspended" in the ordinary way, he was fitted with a plaster jacket. After this suspension he lost consciousness (he thinks owing to the heat of the room, in which there was a large fire) and fell down. He thinks he fell in a sitting position. Immediately afterwards he was very weak and had to be carried back to bed, to which he was subsequently confined. About fourteen days after this fall he could not move his legs at all, and had lost all power of feeling in them. At the same time he lost control over his bladder and rectum. Since this period he has remained absolutely paralysed up to the present time. He says that after the fall the curvature in his back became much more noticeable. He left the hospital in November and went home (into Gloucestershire), and since then there has been little or no change in his condition. Whilst motions are passing unconsciously his legs often become drawn up.

*Present condition.*—There is nothing wrong about the movements or sensibility of the head and neck. Special senses unaffected, except that the right eye was removed some years ago after an injury with a catapult (and he wears a glass eye).

Arms unaffected ; movements natural, and sensibility good.

Symptomatology of Total Transverse Lesions of the Spinal Cord," in *Med. Chir. Trans.*, 1890, p. 151.



**Back.**—There is a prominence of considerable size at the level of the sixth, seventh, and eighth dorsal vertebræ. It projects for some distance and the skin over it is reddened and soft. No abscess detected. There is no marked tenderness on pressure over the prominence. There is a lateral curvature of the lower dorsal vertebræ to the left, and of the cervical to the right; the dorsal curvature being most marked. The chest bulges on the right side. Nothing unnatural discovered about the heart or lungs.

**Legs.**—Not markedly wasted: there is not the least power of movement in either leg. They are generally extended and rigid. The rigidity of both hip and both knee joints is extreme; the ankles not being so markedly stiff. Under very firm pressure the rigidity gives way; the legs become flexed, and then there is difficulty in re-extending them.

**Sensibility.**—There is absolute anæsthesia to touch, pain, temperature, and muscular sense over the whole of the lower extremities and lower part of the trunk—in front below a line about one inch above the umbilicus, and behind below the level of the twelfth dorsal vertebra.

**Reflexes.**—Plantars active in both feet. Ankle-clonus present on both sides. Knee-jerks equal, exaggerated; patellar clonus marked. Muscular irritability increased. Skin reflex very active; on pinching either leg it becomes drawn up. Cremasteric and abdominal reflexes not obtained; epigastric present. Urine and fæces passed unconsciously; he never has erections.

Has no bed-sores.

**Electrical reactions:** muscles act well to faradism. No pain or sensation of any kind is caused even by the strongest currents.

The patient was put upon a water bed; was ordered *Ol. Morr.* ʒj; *bis die*, together with *Pot. Iodid. gr. v.*, and *Syrup. Ferri Iodid. ʒj*; *ter die*.

**April 2.**—When the patient wishes to extend either leg he pinches the thigh on the outer side; but when he wishes to flex the leg he pinches the thigh on the inner side; and in each case the desired result follows. The swelling over the prominent vertebræ has increased, and the skin is reddened, but there is no pain on pressure.

**April 8.**—Tested with a surface thermometer the following results were obtained:—on calves of legs, *R.* 95°, *L.* 95°; on fore arms, *R.* 91°, *L.* 92°; on abdomen, above the level of anæsthesia 97°, below this level 97°. Injection of *gr. ½* of pilocarpine was followed by marked sweating above the level of anæsthesia, the skin remaining dry over the anæsthetic regions. (Later there was sweating all down the back, as well as over the glutei and backs of the thighs.)



April 17.—Can feel the point of a pin on the plantar surface of the right great toe. (This sensibility disappeared within three days.)

May 11.—No sensibility found since last note.

June 26.—Till to-day there has been no further evidence of sensibility in the legs. Now there is a small patch, not more than  $\frac{1}{4}$ -in. square, where touches and pinches are well felt, situated just below the outer side of the right patella. At first strong touches seemed to be felt on the inner side of the patella, but further investigation showed that these touches were only appreciated when the patella was moved.

July 1.—The above-mentioned area of sensibility lasted till to-day, but this region has now again become anæsthetic. The rigidity with exaltation of deep reflexes continues as before; also the incontinence of urine and of fæces.

July 8.—This morning some doubtful evidences of sensibility over the middle toe of the right foot were discovered.

July 13.—The tendons of the second and third toes contract in response to voluntary effort, producing slight movements of these toes. Sensation in these toes doubtful; localisation incorrect.

July 14.—Some sensation to-day about middle of right sole.

July 23.—Movements of the big toe and of the second and third toes in response to voluntary efforts. Sensibility extending from the toes on to sole of foot. No sensibility in other parts of affected region.

July 24.—Return of sensibility on the ball of left foot corresponding to fourth toe.

Aug. 4.—Can now move all toes of right foot, and very slightly the big toe on the left side. Can now feel over right foot and outer side of right leg, and also on the left sole. Says that he can now feel that he has legs, and that it seems as if he had tight stockings on.

Aug. 18.—Tactile sensation restored up to both knees. Flexion and extension movements of toes in both feet, plus on the right side. Has slight sensation now before water passes, which occurs regularly about every eight hours. The upper limit of insensibility to touch and painful impressions remains as it was in April last.

Oct. 8.—Since the last note improvement has steadily continued; patient can now draw up the legs in bed, and can move the toes freely. There is nowhere complete anæsthesia, touches with some pressure being felt everywhere, and on the feet and toes the lightest touches are felt. Extension of the legs has been effected by weights, on account of the involuntary startings to which they were subject; these, however, are now much less. The bladder still empties itself



about every eight hours: the patient is conscious, before this happens, of a burning sensation which enables him to tell when the water is about to pass, though he has no sensation while it is passing.

Dec. 4.—Gradual increase of power in legs; much less rigidity and involuntary contractions. Extension left off for a time, but as patient felt more comfortable with the weights they were resumed.

Jan. 6, 1892.—The rigidity and involuntary contractions have still further decreased; patient can now do without the weights. Still active knee-jerks and ankle-clonus. Sensibility improving; very much less impairment. Still no control over sphincters.

Jan. 20.—Can now raise each leg off the bed, and bend knee to right angle; can flex each foot through angle of about 30°, and move all his toes. The reflexes remain as they were on admission; the cremasteric being still absent. Over the previously anæsthetic regions he can now feel feather touches at any point, although he sometimes does not localise them quite correctly to a few inches. His legs occasionally become drawn up at night, when he has to push them down with his hands—as he has continued to do without the weights. Now ordered daily massage to trunk and legs.

Feb. 6.—Feels legs are getting stronger. Sits up in the evenings now.

March 13.—Sensibility much as before. Still no control over bladder. Less starting and drawing up of legs, and they are stronger. Ordered constant current on alternate days from back to feet, the latter being in water; and *Mist. Quinæ 3j, ter die*.

June 16.—Patient can now sit up in the chair for half a day without fatigue or pain. He can also walk in a go-cart fairly well, but cannot yet stand alone. All the movements of legs are much more powerful, but there is still considerable weakness of the flexors of the thighs. Tactile sensibility in the legs almost perfect, and he localises very well. Sensibility to painful impressions is also good. Ankle-clonus well marked; knee-jerks equal and very exaggerated. Still no control over bladder, but has just long enough warning to enable him to help himself. No control over rectum. Legs never start now, but sometimes they become rigid at night. Sleeps and takes food well, and looks altogether better. Ordered *Syrup. Ferri Phosph. 3j, and Maltine 3j, ter die*.

July 12.—For a few days had had a slightly raised and variable temperature: it has stood each night at about 102°. On examining chest, dulness was found on the left side, with other signs of pleural effusion. About 20 ounces of straw-coloured serum were removed by aspiration.



July 14.—Another 37 ounces of serum removed by aspiration to-day.

July 27.—Much better again; temperature normal; heart's apex back in ordinary position, and remainder of fluid is being absorbed. For the last three weeks has been having the constant current applied daily, with the positive pole above the pubes, and the negative pole to the perinæum, and he now has rather more power over the bladder and the rectum than he had before the adoption of this treatment.

This case is undoubtedly a remarkable one. It is, of course, common to find that the ordinary cases of paralysis associated with Pott's disease (in which there is little or no sensory paralysis) completely recover in from twelve to eighteen months. This, however, was not one of the ordinary cases; a fact that was shown by the abrupt aggravation of the patient's condition after his fall, and also by the total loss of sensibility in the legs. The former feature pointed, in my opinion, to the supervention either of a thrombotic softening, or of a myelitis. This still seems to me to be in part, but only in part, the correct explanation of the case. The sequel compels us to suppose that with the softening or the myelitis, there was an association of grave functional defect in the spinal cord, the presence of which caused the case to appear for some time one of much greater gravity than it has subsequently proved to be. Had there been an actual organic lesion, whether in the form of thrombotic softening or of myelitis, affecting almost the whole thickness of the cord, and to such an extent as to have caused complete motor and sensory paralysis, no such recovery as has taken place could have been looked for. Present knowledge forces us to postulate, therefore, in this case the existence of a well-marked functional degradation of the cord, altogether in excess of what could have been caused by the co-existing organic lesion.

In the last two cases we have seen functional disease simulating or associating itself with the paralysis that goes with Pott's disease; it is, however, much more common to find it simulating or associating itself with insular or disseminated cerebro-spinal sclerosis. Instances of this latter class of cases often present extreme difficulties in the way of our arriving at



a definite diagnosis. This point has of late been forcibly and ably dwelt upon by my colleague, Dr. Buzzard, in his little book,<sup>1</sup> "On the Simulation of Hysteria by Organic Disease of the Nervous System."

The functional cases in which there is more or less simulation of, or an alliance with, disseminated sclerosis, pertain I believe for the most part to the category which we are now considering—that is, they are cases of functional paralysis of spinal origin belonging to the spastic type. I will relate three such cases; one in which the diagnosis was comparatively easy, one in which it was for years doubtful, and another also of a doubtful character, but in which, as in the last, there seems to be an admixture of functional with organic disease of the type in question.

We will take the simpler case first.

CASE 12.—Mrs. B——, aged 39, was seen by me in consultation with Dr. J. E. Squire on Nov. 28, 1891.

*Previous history.*—She had been married sixteen years; had never been pregnant. Catamenia always very irregular in time, and often excessive. About ten years ago she had a small abscess in front of the thorax, and some months afterwards a larger abscess between two ribs on the left side. Had had no bad illnesses previously.

Two months after the appearance of this last abscess, and when she had had much domestic unhappiness, she began to feel weak and lame on the left side. She soon had pain in the left leg and in the back, on account of which she kept to her bed for two weeks. She then went away for change of air to Hastings. After she had been there two days both legs gave way suddenly (when dressing), and she fell to the floor. From that time onwards for two years she lost all power of moving both legs. She had to keep to her bed, or to a couch; there was not the least voluntary movement of either leg, though there were some involuntary twitchings both by day and night. At the expiration of two years, when she was first seen by Dr. Squire, rigidity of the legs was constantly present. There was no actual incontinence, but great urgency immediately on desiring to micturate or defecate. She had two small bed-sores during this time. She could not sit up without much support, but her hands and arms were never affected. The muscles of both lower extremities became distinctly wasted. Soon after Dr. Squire began to attend her she became able to move the toes on each side, and to flex other joints

<sup>1</sup> London, 1891.



slightly. This was after some massage and faradisation of the leg muscles, which responded freely to the current.

Some very slow improvement continued till six months ago, when she had an attack of influenza which left her very weak; and since then she has not made the slightest advance.

*Present condition.*—Face symmetrical. Movements of eyes good; no nystagmus. No tremors of tongue or lips; no impairment of articulation. All movements of upper extremities good, without tremor or signs of ataxy. When sitting can move left leg at ankle and knee very slightly; but these movements are executed rather better on the right side. There is some rigidity of both legs at knee. Knee-jerks greatly exaggerated, and ankle-clonus very distinct on both sides. There has been much loss of sensibility in the left leg (no hemianæsthesia), and to a slight extent in the right. Now feels pin pricks on either side but not light touches, and less on the left than on the right side. Only slight diminution of muscular sense in lower extremities. Sensibility of face and of upper limbs has been good, and is still found to be so.

Now walks with great difficulty, powerfully supported on one side, and with the aid of a stick on the other side. Takes very slow, short steps, especially with the left foot, the leg on this side being brought forward with much difficulty. No unsteadiness when she stands with feet together and eyes closed.

She still experiences urgency in regard to the action of the bladder and rectum.

Dr. Squire says she has had "moral treatment" principally, combined with some faradisation. He has insisted during his weekly visits on the patient making attempts to move or walk. He has always thought that the malady was a functional one, though he says many other doctors have taken a different view. He thinks there has been no sexual intercourse for several years, and he suspects that even previously it was very imperfectly accomplished—he fancies, in short, that she has "never had a chance of becoming pregnant."

Tonics were suggested for the improvement of her general health, together with regular massage; also that she should have sulphur baths, and the constant current run through the spine on alternate days. The opinion was expressed that a more vigorous treatment carried out for some months might yet result in a cure.

This case is clearly one of functional, rather than of structural disease, and seems to belong to the spinal type now under consideration. The alliance of the symptoms with those of disseminated sclerosis is only slight; still their long duration,



the rigidity of the lower extremities, and the exaggeration of the deep reflexes, might be considered to point somewhat in this direction. The sudden exaggeration of the weakness—its abrupt development, in fact, into actual paralysis, together with the great irritability of the bladder and the rectum, are not unfrequently met with in functional cases. Some amount of muscular atrophy and bed-sores are also, as we shall see further on, occasionally to be met with in these functional cases, so that their presence here need be no bar to such a diagnosis. The protracted duration of the illness was doubtless dependent, in great part, upon the fact that during the earlier years doubts were entertained as to its nature, and it was thought by some of her medical advisers to be due to an organic cause, while during the time that she has been under the care of Dr. Squire, motives of economy seem to have prevented her treatment from being sufficiently active and energetic. Frequent medical visits, massage, electrical treatment, and baths of one or other kind are needed in such cases; but when the sufferer is above the status of a hospital patient, and yet not wealthy, an energetic treatment of this kind (extending probably over several months at least) becomes for many too expensive to be thoroughly carried out, even if the slow progress that alone can be made in some of these chronic cases should inspire sufficient faith to make patients or their friends desire its continuance.

The next case is one in which the simulation of disseminated sclerosis was very close—it was, in fact, regarded by me (and also by other physicians) as more probably an irregular or unusual form of that disease, than one of a purely functional type. The sequel, however, shows, I think, that it was a mixed case, being to a large extent functional, though with an actual basis of organic disease. Being a remarkable case in many respects, and very prolonged, the notes are necessarily somewhat voluminous.

CASE 13.—Amy S——, aged 24, was admitted into University College Hospital under my care on Aug. 18, 1887. (H. P. Dean, M.B.)

This patient first came under the observation of Dr. Beevor as an out-patient at the National Hospital for the Paralysed and Epileptic in June 1884, and subsequently while she was an in-patient for a



short time at the same hospital under the care of Dr. Ferrier. Dr. Beevor has published some valuable notes of her case (*Brain*, 1888, p. 112), from which I make the following extract :—

*Previous history.*—"Noticed seven years ago (when aged 17) that she gradually became weak in the right hand and arm, and at the same time they felt numb; she frequently dropped things, and had difficulty in picking up small objects. Two months later she noticed that the right leg felt heavy and numb; she had some difficulty in walking, and the leg dragged after her. One year after the onset she found out that she had lost feeling in the whole of the right half of the body. Two years from the onset the left arm began to be affected with numbness and weakness, similarly to the right arm; the left leg was subsequently affected, though to a less degree than the right.

"She had measles when fifteen years old; she never quite recovered her health after this illness, and her present illness came on about two years later.

"At different times she has had sharp shooting pains in the right arm, lasting only for a second or two.

"Since the onset of her illness she has had some difficulty in holding her water."

Dr. Beevor's notes give full details as to her powers of movement, and also as to her various defects in sensibility at this time, which he summarises as follows:—"Almost complete anæsthesia of the right half of the body and limbs, and a considerable amount of anæsthesia of the limbs of the left side, and to a less degree of the left half of the body; loss of muscular sense as regards position and the appreciation of weights, together with marked ataxia in all four limbs when the eyes are closed. Associated with these symptoms there is very little paralysis. . . . She is able to walk a mile leaning on another person's arm, and although she has lost the finer movements of the right hand, and she has some difficulty in moving the other joints of the right arm, there is no marked paralysis. . . . There is ankle-clonus and excessive knee-jerks on both sides, but there is no rigidity of the lower limbs." Dr. Beevor adds: "She was a well-made girl, and though rather apathetic, she did not present any characters pointing to hysteria."

When she came into University College Hospital the following additional facts were elicited.

The catamenia did not commence till she was twenty years of age, and since then her "periods" have been very irregular in time, six months sometimes intervening, when the flow was often excessive.

Till she was eighteen years of age she had lived a very healthy



life in different parts of the country. Since then she has lived at Willesden. Her food has generally been plentiful and good.

There is no neurotic family history, except that one sister suffers from "fits"; no history of rheumatism; one sister and one brother died of pulmonary consumption, but no further history of phthisis can be ascertained.

*Present condition.*—Patient's intelligence and memory are unimpaired. Has no pains in the head and has never had any. But from the beginning of her illness she has frequently had a dull aching pain at the back of the neck, and on sitting up this passes down the back and is then most marked in the lumbar region.

Smell and sight are unaffected. Hearing dull on both sides. Taste also defective on both sides. Sensibility of face impaired on both sides; cannot feel a light touch of the finger, though deeper impressions of the finger she feels equally on the two sides.

All movements of eyes good; no nystagmus (a month later there were some slight nystagmoid movements on looking towards the right only). Pupils large, equal; sensitive to light and accommodation. Right naso-labial fold distinctly more marked than the left; but angles of mouth seem to be raised equally. Tongue when protruded deviates markedly to the right side; but no tremors or wasting exist on either side. Articulation and deglutition unaffected.

Spasmodic contractions of the left sterno-mastoid occur from time to time.

Patient is unable to pick up small objects with either hand. She cannot raise right hand to her mouth, but she can the left, and with difficulty she can put this hand on the top of her head. No fine tremors or spasms when she attempts to pick up things. Cannot move the dynamometer with the R. hand; but with the L. her grip is 50. The fingers of the right hand are habitually flexed and the thumb is turned across the palm. On trying to straighten the fingers, well-marked rigidity is found. A similar general condition is present in the left hand, though it is much less marked. The hands, especially the right, are generally covered with a cold clammy sweat, while the skin of the body is dry.

The right wrist can be flexed and extended to a slight extent only; the movements of the left are only slightly impaired.

There is considerable rigidity of the lower extremities, which are extended; and it is difficult to flex them. For this reason and because of the weakness of her arms she can only raise herself into the sitting posture with difficulty. She can just raise her legs from the bed for a few inches; the left rather better than the right.



Her gait is very unsteady, and she drags her feet along the ground. She can take a few steps without support, but soon begins to sway about a good deal.

Electrical reactions.—Reaction to faradism good, though better in muscles of left than in those of right arm. Reaction to voltaic current better in arms than in legs, and equally so on the two sides. Tongue muscles respond equally on the two sides to both currents.

Reflexes.—Abdominal exaggerated on both sides; plantars exaggerated on both sides.<sup>1</sup> Ankle-clonus present on each side; knee-jerks much exaggerated on both sides.

Sensibility.—Slight prick of pin not felt over either upper extremity; a stronger prick feels like the touch of a finger on the right arm, but is recognised as such on the left. Cannot feel light touches or pin-pricks on trunk, but can distinguish stronger impressions. On legs cannot feel light touches or pricks of pin, but when blood is drawn she can just feel the prick. She cannot distinguish the difference between hot and cold objects placed against the skin of trunk or extremities, but she can just distinguish them on the face.

Muscular sense is very defective in both lower extremities; she cannot tell the position of her legs after they have been moved passively. When standing with feet close together and eyes closed she sways in a marked manner, and would fall if not supported.

Sphincters.—Patient occasionally passes her urine under her, but not so frequently as she did two or three years ago. There has never been any trouble with her motions, except that she is very constipated.

Sept. 30.—The spasmodic contractions of the left sterno-mastoid still continue; the muscle becomes rigid, and the head is turned towards the right side. Tongue still deviates markedly to the right side. When the eyes are turned to the right side there are distinct nystagmoid movements, chiefly in the right eye. On looking to the left there are no such movements in either eye. Patient cannot take up a small glass with her right hand at all; and on raising it to the mouth with the left hand there is a "considerable amount of uncertain movement." Both arms are weaker than on admission, and the rigidity is distinctly more marked. Grip: R. 0; L. 30. Plantar reflex absent. Knee-jerks and ankle-clonus more marked than formerly. She can still walk about, holding on to objects, but not so easily as on admission. Condition as to sensibility remains about the same. The patient has mostly been taking five-grain doses of iodide of potassium in a bitter infusion, three times a day.

<sup>1</sup> Later the plantar reflexes were noted as absent.



Oct. 10.—There is no nystagmus to-day. Ordered three sulphur baths a week.

Oct. 24.—Still no nystagmoid movements. Pain along the spine is still complained of, principally in the neck and in the lumbar region. Deep pressure over the spine seems to reveal more tenderness than pinching the skin. The patient also seems weaker in the back muscles and does not raise herself so easily in the bed, though this may be due to increased weakness in the arms. There is distinctly more rigidity in the upper limbs than on admission; and the contraction of the fingers is more marked. There has been a slow increase in the weakness of both arms. The gait is not quite so good as on admission. There is more rigidity in the adductors of the thighs. Irritability of the bladder is less.

Nov. 9.—There is a slight improvement in the patient's condition. She can now fairly well open and shut the left hand, and the rigidity of the fingers has nearly all disappeared. The right hand has also improved a little; she can open it to a slight extent, but the wrist is still kept in a flexed condition. The legs remain in much the same state. Discharged.

Oct. 22, 1888.—This patient was admitted under my care into the National Hospital for the Paralysed and Epileptic, in a worse condition than when she left University College Hospital, as for the last two months she had been unable to walk at all.

*Present condition.*—(Dr. Risien Russell). Fairly nourished. No pain except in back. Complains of increasing weakness of both arms and both legs. Ocular movements natural; no nystagmus. Tongue deviates distinctly to right. Palate normal. Voice rather husky. Vocal cords healthy.

Upper extremities in much the same state as already described. Right still worse than left in all respects, and very rigid. Left much less rigid; can move all the joints; but cannot use hand for any fine work. There is much inco-ordination on trying to put finger to nose, but no tremor. The sensibility of both arms is affected in much the same way as before. Elbow- and wrist-jerks are exaggerated.

Tenderness all along the spine, not affected by position, and not specially localised. Still great anaesthesia and analgesia of trunk.

Lower extremities.—Both limbs quite rigid. Cannot walk at all. As she lies in bed thighs are firmly adducted, and the knees and ankles are rigid in the extended position. The soles of both feet are sweating freely. There is slight wasting of both limbs.

Reflexes.—Knee-jerks much exaggerated; ankle-clonus readily



induced; plantar reflexes present and equal. Muscles not irritable to direct percussion. Tactile sensibility is abolished up to knee on right and up to middle of calf on left side; above (up to trunk) it is greatly blunted on both sides. Painful impressions abolished over similar areas; and in thighs there is more blunting than for tactile impressions. Ordered Sodii Iodid. gr. viij., Liq. Arsenical. ℥. iij., Sp. Chlorof. ℥. x., Aq. ad 3j, ter die. Later on she was also ordered three sulphur baths a week.

Feb. 24, 1889.—There has been no definite improvement in the patient's condition during the four months that she has been in the hospital. Discharged.

On Nov. 6, 1891, I went to see this patient at St. Peter's Home, Kilburn, in response to an invitation from Dr. Waterhouse. I was then informed that up to about three weeks ago she had remained in much the same condition as when she left the Queen Square Hospital in February 1889. During the interval, she had been for some time in St. Mary's Hospital; and also had been living in St. Peter's Home for over twelve months without any appreciable change for the better having taken place.

Three weeks ago she was put into a ward with a girl suffering in part from functional paralysis, who greatly improved after some injections of the fluid lauded by Brown-Séquard. Under the strong influence of suggestion our patient was then put through a course of twelve injections of the same fluid, and the result was a remarkable improvement in the girl's condition. In his letter, Dr. Waterhouse told me that she could now write her name and feed herself with her right hand (this I did not see myself). I saw her sitting up in bed, however, without support; I saw her move the right hand and fingers, and found her grip with my dynamometer to be R. 15, L. 25. She could move the right arm at the elbow and at the shoulder, and the rigidity of the limb was only slight. The rigidity of the legs was also very much less; she could perform all movements with each limb slowly. I saw her stand, holding on to the back of a chair, and take a few short steps. The knee-jerks were still exaggerated and there was ankle-clonus on each side. The sensibility of the limbs and trunk seemed to be much less impaired than it was when she was at the Queen Square Hospital.



Early in April 1892 I again examined this patient with Dr. Waterhouse, and found her to be in substantially the same condition as when I last saw her. Her improved state had been maintained, but no further progress had been made.

During the time that this girl was under my care, I was on the whole disposed to believe that she was suffering from organic disease of the spinal cord and brain, though I never felt quite satisfied with the diagnosis, which stands in my case book thus, “?Disseminated Sclerosis.” I had only a few years before recorded<sup>1</sup> an “Anomalous case of Disseminated Sclerosis,” running a very chronic course, where the diagnosis was verified by an autopsy, in which from first to last nystagmus and also the characteristic tremors on movement had been absent. Here also there was great irritability of the bladder, and rigidity was a marked feature in all the affected limbs; but sensory disturbances to any notable extent were for several years absent. In this latter respect the case of the girl was notably different, as the sensory disturbances were early phenomena with her, and remained remarkably pronounced throughout. Their predominance ought, perhaps, to have inclined one more strongly towards the view that a large part of her symptoms were due to mere functional degradation of the spinal cord and brain. That, at all events, is the view which subsequent events have now forced upon me.

Although the difficulty in distinguishing certain cases of functional disease from disseminated cerebro-spinal sclerosis is admitted to be often great, it may now be recognised that about the most puzzling clinical picture is afforded by the combination of such conditions which presents itself from time to time. I will next cite another example of what will, I fear, turn out to be a case of this kind. It is that of a young lady who is at present under my care.

CASE 14.—Miss M. L. J——, aged 21, the daughter of a medical man, was admitted into the “Contributing Ward” of the National Hospital for the Paralysed and Epileptic under my care, on June 29, 1892. (Dr. Bowman, Dr. Wood, and Dr. J. J. Kitchen, Cl. Cl.)

*Previous history.*—There is no neurotic family history, though the mother is said to be “very nervous.” The patient had measles badly as a child, but has otherwise enjoyed excellent health. At

<sup>1</sup> *Trans. of Clinical Soc.* 1884, pp. 7-17.



the age of 18 she had a severe attack of diarrhoea, with pain in the abdomen, and after this lost power a good deal in the right arm and hand: found she could not play on the piano, and could only write a little, as her arm would "jerk about when she tried to do so." This lasted about six weeks, when she quite recovered.

About two years ago had some obscure illness for about a week, thought to be due to blood poisoning, and also some slight mental trouble, and to these causes her friends attribute her illness. She then began first to complain of a numbness of the right hand, which has continued up to the present time. It commenced at the tips of the forefinger and thumb, and then spread upwards. About eighteen months ago the right leg began to get weak. The ankle especially failed, so that she trod on the outer side of the foot. This ankle soon became painful and discoloured. Walking became more difficult; and gradually rigidity of the foot and leg set in about fourteen months ago.

Nearly twelve months ago her right knee and ankle had become quite rigid, though the right hip could be bent, and she could still walk with the aid of a stick. At this time she consulted an eminent surgeon, and, after a time, in accordance with his advice, she underwent a course of Weir-Mitchell treatment for a period of three weeks. Under this treatment she improved considerably; the knee and ankle lost their stiffness, and she became able to walk a mile or two with the aid of a stick.

Last January she had an attack of influenza, and at its commencement quite lost power over the right leg for two days. After this illness she remained fairly well till a month ago—walking two or three miles a day, and, during the last two or three weeks, taking some tricycle exercise as well—when one day she slipped and sprained the left ankle.

On account of this accident she had to remain in bed for a week, and at the expiration of this time she began to suffer from numbness in the left hand and fingers, similar to what she had been suffering in the right hand for nearly two years. Two weeks afterwards (that is, a week ago), she noticed great loss of power in the left leg. This became affected in the same way that the right leg had been, only more suddenly. The knee and ankle became stiff, though unequally so; she could bend the knee with great effort, but not the ankle, and has been unable to walk ever since.

Marked irritability of the rectum and bladder has existed throughout the duration of these symptoms. She has also had temporary diplopia off and on for two years; and has suffered from occasional headaches. Has never had a fit of any kind. Catamenia



have always been regular. Has had tenderness in the back for two months, over a considerable area. Has also complained of weakness in the back for the last few weeks—soon getting very tired when she sits up.

*Present state.*—Patient looks as though she were in excellent health; she is plump, her muscles are firm, and her lips and cheeks of a bright red colour. She is 5 ft. 4 in. high, and she weighs 9 stone. She is excitable and lively; but says she has never had any ordinary hysterical attacks of laughing and crying.

Face symmetrical; movements of eyes good in all directions, but there are slight nystagmoid jerkings when she looks to either side; tongue protruded straight, no tremors; speech and deglutition unaffected. Palate moves well and equally; palatal and pharyngeal reflex present. Pupils equal, rather large, reacting to light and accommodation. Sensibility to touch and pain good on both sides of the face; and special senses unaffected, except that she sees double when she looks to either side.

Upper extremities.—Movements of arms good, and there is no rigidity of either limb; sensibility of arms to touch and pain normal. Right hand: tips of thumb and forefinger are anæsthetic to touch and pin-prick. The sensibility of other finger-tips is also diminished; a similar condition exists on the back, and nearly all over the hand. (The whole right arm sometimes jerks during the examination.) Left hand: seems to show a general diminution of sensibility to touch and pin-prick.

Lower extremities.—Left: no distinct rigidity. Can raise leg off the bed feebly; can bend the knee a little, but cannot do so against much pressure. Slight movement of ankle; feeble of toes, is only able to flex them a little. Sensibility to touch and painful impressions normal; sensibility to heat and cold impaired below knee, and absent over dorsum of foot; muscular sense unimpaired.

Right: raises leg off bed well against a good deal of pressure. Knee movements good. Ankle movements very poor; very slight power of dorsiflexion. Toes only flexed very slightly. Sensibility to tactile, and still more so to painful impressions, diminished all over foot, leg, and lower two-thirds of thigh. This diminution is more marked below the knee, but there is no complete anæsthesia anywhere. Sensibility to heat and cold is only impaired just below the knee; but from half way down the leg it is more completely absent. Muscular sense unimpaired.

Electrical reactions.—Diminished to faradism on both legs, but more so in right than in left; galvanic reactions could not be properly tested because of the reflex spasms which were induced.



Reflexes.—Plantars present equal; abdominal not obtained. Knee-jerks equal and very distinctly exaggerated. No ankle-clonus on either side.

Vaso-motor changes.—Drawing the finger-nail across the skin of the abdomen on either side gives rise to a slowly evolved, deep red, persistent *tâche* bordered by a broad margin of extreme pallor. Drawing the finger across the skin of each calf produces no red *tâche*, but a slowly deepening and widening band of extreme pallor.

Spinal column.—There is some tenderness over lower dorsal and lumbar regions, but it is not most marked in any particular spot. There is no sign of angular curvature, and there is no pain on percussion or pressure.

Gait.—She is unable to stand without much assistance. When thus supported on one side, and with the aid of a stick on the other, she takes very short steps, shuffling the feet along the floor, from which they are not raised at all.

Examination of the thorax and abdomen reveals nothing unnatural.

Ordered Mist. Quinæ ʒj., *ter die*; to rest in bed; and to have faradisation, the wire brush, and massage daily to the lower extremities.

July 27.—She is distinctly better. Raises both legs well off the bed; can bend knees strongly against pressure, also the ankles, and about equally on the two sides. The sensibility of the right leg has also very much improved; and she states that she feels the wire brush much more than she did at first. Knee-jerks still exaggerated, and ankle-clonus now well marked on both sides. Irritability of bladder and rectum continues; but is rather less than formerly. Nystagmoid movements of eyes as before, and equally whether looking to right or left. No diplopia for the last two or three weeks. Abdominal *tâche* much as before; but the pallid *tâche* on calves is much less marked, being scarcely visible on left and only slightly marked on right side. She can sit up better, and gets out of bed more easily. Gait is improved. She can now walk slowly along the ward with the aid of a stick only. She takes better steps with each foot, no longer shuffling them along the floor. Gets up after tea every day now. Electrical treatment and massage continued.

Aug. 26.—General health remains very good; patient has, in fact, a typically healthy and florid appearance. Since admission she has on five occasions had an involuntary passage of *fæces*; though this has not occurred during the last fortnight. The bladder remains irritable, but there has been no actual incontinence. The degree of nystagmus varies from time to time; it is generally slight though



distinct.<sup>1</sup> No pharyngeal anæsthesia, but the reflex is sluggish. Tongue, no tremors. Speech normal. Motor power of arms very fair; grasp of right hand rather less than that of left.

Upper extremities.—There is decided volitional tremor of the arms (*e.g.*, in touching tip of nose), increased slightly on shutting eyes. This is greater on right than left side. After writing a few words the hand jerks away. Can knit fairly well.

Sensation.—Normal in both arms and forearms. Some slight anæsthesia and analgesia about portions of fingers and palms of both hands: more extensive now in right than left. Localises correctly. Sense of position very defective for right thumb and index fingers.

Lower extremities.—There is decided improvement in the power of movement at all joints. Can flex and extend toes freely. Can dorsiflex ankles much more strongly. Fair flexion and extension at right knee; still not quite so good at left knee. Flexion at both hips pretty good.

Gait.—Walks with aid of one stick. Walks slowly but takes longer and better steps. There is a slight tottering character in her gait, and a peculiar sort of tremulousness.

Reflexes.—Knee-jerks exaggerated, and equally so. Ankle-clonus not obtained. [Patient was in bed when this examination was made. The next morning, after the patient had walked a little, and whilst sitting on the edge of the bed, I obtained distinct ankle-clonus on each side.] Plantar reflex obtained with difficulty in right, and not obtained in left foot.

Sensation.—On legs and feet there is now no anæsthesia, except for some very slight blunting of sensibility on sole of right foot. The analgesia of right leg and foot has practically disappeared; and the sensibility to painful impressions is good over the whole of the left leg and foot. The sense of position is lost only in the right big toe, and is somewhat vague at the right ankle; elsewhere it is natural.

A tepid needle bath was ordered three times a week, in addition to the massage and electrical treatment.

When this patient was first seen, the history of the previous attacks, the mode in which they had supervened, together with their temporary character, and the considerable amount of anæsthesia existing in the right lower extremity, made me incline to the view that this was a simple case of functional

<sup>1</sup> On Sept. 2, for the first time, I found no nystagmus or unnatural movements when looking to either side.



paralysis. This view was at first also, for four or five weeks, rather confirmed by the way in which the anæsthesia cleared up, and the motor power improved under treatment. Since then, however, the fact of the persistence of the slight nystagmus, the occurrence of the incontinence of fæces, and the comparatively stationary character of the patient's motor disabilities, have been gradually inspiring me with the fear that there are actual structural changes in the spinal cord over and beyond the mere functional degradations that may have co-existed with them. I have been more and more impressed also by the look of florid health presented by this young lady, which is so different from that commonly met with in patients suffering from functional paralysis, either of cerebral or of spinal type, but which is not so rare in patients suffering from disseminated sclerosis. When taken alone, it is true, the other reasons have little or no cogency for driving one to such a view. The persistence over a few months of the motor disabilities would, of course, go for little; slight nystagmoid movements again are to be met with in functional cases;<sup>1</sup> and, as we shall see, actual incontinence of urine and of fæces are to be met with occasionally in functional cases,<sup>2</sup> extending over weeks or months, whilst a marked irritability of bladder and rectum (which may lead to such accidents from time to time) have been found by me to be common features in these cases. Still, although there is no certainty as yet, there is grave reason for suspecting in this case the co-existence of actual organic disease.

The difficulties of diagnosis seem to culminate in such mixed cases as those which I have last recorded. We now come again to something of a simpler type; and yet the next case is difficult enough of explanation, if we attempt to trace out its exact pathogenesis. The patient here was a very unhealthy subject. It was not so much a case of paralysis, but one of recurring and prolonged tonic spasms, more or less marked in all the limbs, and associated with obstinate attacks of prolonged vomiting, as well as with several rheumatic attacks. Here there were no defects of sensibility; and although the patient had been suffering from more or less

<sup>1</sup> They were present in my Cases 9 and 13.

<sup>2</sup> They existed in my Case 22.



general rigidity of the limbs for over twelve months before she came under treatment, she soon began to improve, and in about two and a half months she left the hospital cured of the rigidity, and with distinctly amended general health.

CASE 15.—Caroline G——, aged 26, was admitted into University College Hospital under my care on March 3, 1892. (J. E. Paul, M.B.)

*Family and past history.*—Patient is unmarried and is one of eight children. Her family history is good, with the exception that her eldest brother is suffering from some form of insanity, and is at present in an asylum. In childhood the patient suffered from measles and scarlatina. She has never had a fit of any kind. Her health has been more or less bad for the last thirteen years. She says she first began to suffer from “cramps” in her hands and arms, and soon after, about the last week of Jan. 1879, she became rigid all over her body. She remained in this state for three days. Her joints then became swollen and painful, and a doctor who was called in said she was suffering from rheumatic fever. She was laid up with this attack for three months. In December of that year she was admitted into Guy’s Hospital on account of a powerless condition in the legs. She was treated with electricity, and remained nine weeks. When she left she was decidedly better and could walk about a little.

After this she was fairly well for some years, except that she had several attacks of “rheumatism,” and in the year 1885 she was taken to the Reading Hospital, suffering from “rheumatic fever and congestion of the lungs,” where she remained for nine weeks.

In Jan. 1886 she began to suffer from severe vomiting (which continued for fourteen months), and also with severe pains in her head. On account of these symptoms she was again in Reading Hospital for a period of nine weeks. As the vomiting did not improve she left; and it did not cease till the following March.

She then remained fairly well for one year; but in March 1888 she lost strength in her hands and arms, and she says they wasted. On account of this she was advised by her doctor to go to the mineral waters at Bath. She went, and remained there seven weeks, but was unable to undergo any treatment because her vomiting recommenced. About six weeks after her return from Bath her hands became drawn up and quite stiff. She remained in this state for eight months and then the rigidity disappeared.

She continued for another eighteen months in a fair state of health: being able to walk about and use her hands a little. On Dec. 27,



1890, she was again taken with violent vomiting, and from this time she began to suffer also from constipation. The vomiting continued more or less severely, and in Feb. 1891 she had another "attack of rigidity" all over her body. The vomiting and constipation, together with this rigidity, and trembling at times, have been more or less present ever since. There has been some blood with the vomit at times; and she has been told that she was suffering from an "ulcer of the stomach."

She began to menstruate at 13 years of age. Her "periods" at first recurred every fourteen days. This was the case when the first attack of rigidity occurred. From time to time she has been irregular. Had been suffering from amenorrhœa for months before the last attack of rigidity, and thinks this had been the case before previous attacks. (Was "regular" during her stay in the Hospital).

*Present state.*—Patient is a pale, unhealthy-looking girl, of medium height. Her eyes have a vacant, staring aspect. There is no ocular palsy, and no nystagmus; pupils react to light and accommodation; conjunctivæ of normal colour. She is well clothed with subcutaneous fat, and there is no apparent wasting anywhere. Except for a few acne pustules on the back and chest, the skin presents a normal appearance. She answers all questions readily and rationally. She lies in bed with the legs in a state of complete extension with rigidity, and there is also spasm of the adductors of the thighs. The limbs cannot be bent at either of the joints with any ordinary amount of force. She cannot now move them herself, and attempts to do so cause very distinct tremors in the limbs. She cannot sit up in bed. There is a lesser amount of rigidity also in the arms, which are in a partially extended position; she is able to move these limbs feebly, but with the accompaniment of marked tremors of the whole limb. The movements of the right arm are more limited than those of the left, owing to a more marked rigidity of its shoulder muscles; but the tremors are more marked in the left arm. Her grip cannot be tested on either side owing to partial contracture of the hands.

There is no loss of sensation to be discovered anywhere, but over the outer and lower third of both thighs there is diminution of tactile sensibility, though there is no delay in transmission, and the localisation is good. No hyperæsthesia anywhere. Sensation to painful impressions, to heat and cold, and muscular sense are normal.

*Reflexes.*—Plantar absent; knee-jerks not to be obtained owing to the rigidity, but on tapping the detruded patella, a distinct ankle-clonus is to be obtained on each side. No wrist-jerk on either



side, but tapping of the triceps tendon produces a clonus of the forearm.

Patient at present cannot walk or stand, owing to the rigidity. No trophic changes are to be seen; and the sphincters are unaffected.

There is no optic neuritis; and the functions of all the cranial nerves seem to be unaffected.

Heart, lungs, and kidneys appear to be healthy, and there is no enlargement of liver or spleen. Tongue moist, but furred; appetite fair; she has slight nausea, and vomits occasionally. Bowels are rather costive. Sleeps badly.

She was ordered an extra milk diet; and to take Calomel. gr. v., followed by a saline aperient; also Potas. Bromid. gr. xx., om. nocte; and to have three sulphur baths a week.

March 7.—The rigidity in the upper limbs is markedly diminished, and in the legs to a less extent. The right knee can be bent slightly. Patient has vomited twice, the vomit having been stained with blood on each occasion. Her temperature last night went up to 100° F., but it returned to the normal after an hour or two. No unnatural chest symptoms can be detected.

March 10.—The rigidity in the limbs continues to diminish distinctly. She can bend her right leg nearly to a right angle, though she is still quite unable to move the left leg. The rigidity in her left hand has disappeared; it continues in her right hand, but is distinctly less. On attempting to move her limbs a very marked tremor still occurs.

March 14.—Can now lift the left leg off the bed; the effort being accompanied by distinct tremors. Moves other limbs as before. She vomited three times yesterday. Ordered Mist. Bismuthi ʒj., ter die; she still takes a full milk diet.

March 22.—The rigidity is still diminishing. She can move both her legs fairly well, the right leg especially. The rigidity in her left hand has disappeared, and that in her right hand has also diminished. The tremor on movement is likewise less. She has vomited once to-day, not at all yesterday. Ordered massage of the limbs daily.

March 26.—Patient was tested for alterations in sensibility this morning. The two patches of anæsthesia on the thighs noted in the "present state" have now completely disappeared. No loss or diminution of sensibility can be made out anywhere, nor was any hyperæsthesia detected. The knee-jerks are markedly excessive. Patellar clonus is still present, but no ankle clonus can be obtained.

March 28.—Patient can now flex both knees to a right angle.



The feet when at rest remain extended, with the toes extended, but she can this morning for the first time flex her ankle joints and move her toes. The right hand still remains somewhat stiff, the fingers being flexed at the metacarpo-phalangeal joints, and the phalanges extended: these can be moved slightly this morning. The vomiting has been better for the last two days. Marked constipation still continues, necessitating frequent recurrence to aperients and enemata.

April 4.—Patient was put on mincemeat and chicken on April 1. For the first two days she vomited most of what she took, but since then she has retained more than she has vomited. She was also taken out of bed on the same day and placed in a chair before the fire. Her strength has been steadily increasing. There is still some rigidity in the right hand—the metacarpo-phalangeal joints being semiflexed. The rigidity in the legs has nearly disappeared; she is able to bend her legs to a right angle, and flex and extend her ankles quite readily. The tremors previously mentioned have almost disappeared.

April 11.—Patient vomited four times yesterday, and once this morning. This has occurred about half an hour after breakfast and dinner more especially. The rigidity in her lower limbs has still further diminished, and she feels them to be decidedly stronger. She is passing rather a small quantity of water, and it is of high specific gravity, being 1040 this morning. It also contains a deposit of phosphates and urates. The tremor she formerly suffered from has disappeared altogether. She sits up in the chair every day for a few hours.

April 22.—Urine three days after last note had increased in quantity and become lower in specific gravity. Her general condition has decidedly improved. The rigidity noted in her right hand has diminished very much. She can move her fingers quite well at present and flex the metacarpo-phalangeal joints. The vomiting is also improving. Patient is now able for the first time, with support, to walk nearly across the ward.

May 3.—Patient's vomiting which had been worse for some days has improved again of late. She feels better and stronger generally, and is taking her food quite well. She wrote three letters yesterday for the first time. Massage ordered to be stopped, and the sulphur baths which had been suspended to be resumed.

May 17.—Patient is still improving, though the amount of vomiting still varies much from day to day. She continues able to write, and to walk across the ward with assistance.

May 25.—For the last few days patient has been walking about



the ward without any aid, and helping to clean cups and saucers and carry them round to other patients. The tremors have nearly disappeared, but are still seen when she is told to hold out her hands side by side. She vomited once yesterday, but had not done so for two days previously. Knee-jerks normal; no ankle-clonus. Discharged.

During her stay in the hospital this patient showed no unnatural emotional condition, and no tendency to magnify her disabilities; on the contrary, she seemed most anxious to be well, and able to get about again.

In the cases of functional paralysis of spinal type hitherto recorded, the disease has assumed either a paraplegic or a more or less general form; and though cases of spastic functional paralysis of *hemiplegic type* are also not unfrequently met with, these in my opinion are almost always of cerebral origin. They are associated with hemianæsthesia, and are marked by loss of the muscular sense, as in my Case 6.

As was long ago pointed out by Charcot,<sup>1</sup> this form of paralysis often sets in abruptly after a convulsive seizure, and after lasting a variable period, often many years, it may disappear as abruptly, either during another convulsive seizure or under the influence of some very strong emotional disturbance.

Charcot expresses also a very strong opinion that in those cases of spastic paralysis which last over a series of years, whether they be of hemiplegic or of paraplegic type, there ultimately supervenes, not unfrequently, an actual sclerosis in one or both lateral columns of the cord.<sup>2</sup> It seems just possible that we may have an exemplification of this kind of sequence in my Case 13.

It is by no means clear why in certain cases of functional paralysis of cerebral origin we should get a completely flaccid form of paralysis, and in others a paralysis associated with marked rigidity, unless, as I am strongly inclined to think, there is in this latter type an extension of the functional disability from afferent fibres and cortex (to which it is generally limited) so as to involve also the efferent fibres from the kinæsthetic centres—probably in the cerebrum,

<sup>1</sup> *Leçons sur les Malad. du Syst. Nerveux*, t. i., 1872, p. 308.

<sup>2</sup> *Loc. cit.*, p. 316.



though possibly in some portion of the opposite lateral column of the spinal cord.

Not unfrequently, however, we have to do with a spastic paralysis of a *monoplegic type*, and of this the following case is an example.

CASE 16.—Edith Jane E——, aged 15, was admitted on April 21, 1890, into the National Hospital for the Paralysed and Epileptic, under my care, suffering from contracture of the left lower extremity. (Dr. Risien Russell.)

*Previous history.*—For five years she has suffered more or less pain in her left leg, which was supposed to have followed on an attack of rheumatism. The amount of pain in it has varied from time to time. She says she has never during this period been able to walk without a perceptible limp, because she never could get her heel down upon the ground. During the last year she has also had weakness and pain in the right arm; and for the last nine weeks she has had so much pain in her back as to necessitate her remaining in bed—exacerbations coming on every night at about 8.15. She still often has pain in the left knee and hip, and is unable to get the heel down to the ground. Has frequent attacks of loss of voice. No trouble with choking sensations. Her past history in other respects had always been very good. No serious illness at any time. Never had fits of any kind. No neurotic family history.

*Present state.*—Patient is a pale, somewhat feeble, and anæmic-looking girl, complaining of pain in the back and inability to put the left leg straight.

Face: nothing unnatural. Tongue protruded straight. Palate normal. Occasional attacks of aphonia.

Arms.—No paralysis, no tremor, no anæsthesia.

Legs.—As she lies in bed the left leg is flexed at the knee and also at the hip. On trying to overcome the contraction there is great resistance; this can be overcome, however, after considerable difficulty, so that the leg can be straightened perfectly. The movement at the different joints then seems to be free, though very weak. During the manipulation the patient sighs and makes some fuss, but it is evident she does not suffer distinct pain. There is no wasting of either leg. No anæsthesia. Knee-jerks present, active, and equal. No ankle-clonus; plantar reflexes very difficult to obtain.

Spine.—She complains of pain in the lumbar region of the spine; there is some tenderness also to pressure and percussion, but there is no prominence or irregularity of the vertebral spines.



Heart and lungs nothing unnatural. Abdominal organs showing no signs of disease.

Ordered, *Mist. Quin.* ʒi., *ter die*; and *Pil. Col. et Hyoscyam.*, gr. v., p. r. n.

April 29.—Patient was got up to-day. Great apparent difficulty in getting the left leg straight and the foot to the ground. Gradually walked better with assistance, which was then little by little withdrawn. Then she walked alone in a somewhat unsteady fashion, but she did not fall, and as she went on her walking improved.

Ordered to have a tepid needle bath daily; also *Fer. Amm. Cit.*, gr. iv.; *Liq. Strychn.*, ʒ iij.; *Liq. Arsenicalis*, ʒ iij.; *Infus. Aurant.*, ʒ i., *ter die*, *post cibum*; with *Ol. Morr. et Maltine*, āā ʒ i., *bis die*.

May 17.—After last note was made the patient got up daily. There was no recurrence of the contracture, and no tendency even to walk unsteadily. Her general health improved. The nightly attacks of pain ceased on the first administration of Bromide, and did not return. (She had been ordered *Pot. Brom.*, gr. xxx., at 6 P.M.) Discharged to-day.

Here we had to do with spastic symptoms of rather long, though of somewhat uncertain, duration, in a delicate and anæmic girl, which rapidly subsided under firm moral treatment. It will be observed that there was the same complaint of pain, with some amount of tenderness over a portion of the spinal column, which is so common in these cases of functional paralysis or spasm, more especially when of spinal type. The nightly paroxysmal pains in her back, said to have been of nine weeks' duration, ceased, it will be observed, after a single full anticipatory dose of bromide of potassium had been administered.

The next case is one of a more typical and ordinary character, occurring in a young lady whose family history was of a markedly neurotic type, and whose general health had been previously much reduced. When she came under treatment her general health was still very poor; and for several months the means adopted for the cure of her malady produced only a comparatively slight change for the better.

CASE 17.—Miss Evelyn L.—, aged 24, was sent to me on Oct. 27, 1891, by Drs. Wm. and F. W. Robinson of Huddersfield, and the wish was expressed that she should be admitted into the National Hospital for the Paralysed and Epileptic under my care



as a "Contributing Patient," if I should regard her as suitable for admission. I did so regard her, and in the course of a few days she was admitted into the hospital under my care. (Dr. Rivers.)

*Family and previous history.*—[The following details were in great part communicated to me by the gentlemen above named.] The patient is of a decidedly neurotic temperdment, and there is an extremely well-marked neurotic family history. Thus, her grandfather was a dipsomaniac, her father suffers from diabetes, and nine years ago he made a desperate attempt to commit suicide; while one uncle suffers from dementia and another committed suicide.

The patient was much upset nine years ago by the attempted suicide of her father. After this, she suffered from time to time from pains in the left knee. "Otherwise health fairly good with the exception of a long illness of some months' duration two years ago, when she suffered extremely from severe 'neurasthenia.' Her symptoms during this illness were very varied: absolute refusal to take food; distressing hiccough; pains in different parts of the body without any physical signs, etc. She was reduced to an extreme degree of exhaustion, but nevertheless recovered gradually to her usual standard of health, with the exception that for the last year she has complained of pain in the left knee, and also that at times it would give way under her and cause her to fall. There was absolutely nothing wrong to be seen about her knee, but it was extremely sensitive to the touch, so that she would cry out even at the approach of the hand. From this fact and from her previous illness we were induced to look upon the symptoms as 'hysterical.' As she had some very bad falls, and there were bruises testifying to the fact, we thought it possible that there might be some internal derangement of the joint, and, accordingly, on Feb. 12, 1891, I put her knee into plaster of Paris for the purpose of taking a cast for a leather splint. Against our directions, she went out for a walk with the plaster on, with the result that the leg became very much swollen and painful. The plaster was removed and she was kept in bed with the leg raised for some weeks. She complained of pain over the course of the tibial veins, and the symptoms pointed, as we thought, to thrombosis. I should mention that before applying the splint she exhibited no weakness in walking, and there was no muscular wasting. In three or four weeks the swelling subsided, but returned when she attempted to walk, and we could see then that the foot could not be put firmly on the ground and that there was great difficulty in walking. By degrees the foot assumed the position of extreme extension, and notwithstanding all kinds of treatment, including galvanism, massage, etc., it has remained in



that condition for several months." The patient says that about this time she also lost sensibility in the leg below the knee, so that she could not feel a pin-prick or the battery. This loss of sensibility she says has been rather less marked for the last two months. The foot and lower part of the leg have remained swollen up to the present time.

*Present state.*—Patient is a tall, but pale and delicate-looking girl. The movements of her eyes are good in all directions, and there is no nystagmus. Pupils natural, and optic discs normal. Sight, smell, and taste unaffected on either side. Face: no asymmetry, and its sensibility normal. Tongue, very tremulous, protruded straight. Palate reflex absent.

Arms show slight tremors when they are held out in front of her. No distinct paresis, and sensibility not affected. Wrist- and elbow-jerks present, and equal.

Walks with the aid of crutches, and does not put the left foot to the ground at all.

Right leg.—Power good; sensibility natural. Knee-jerk slight. No ankle-clonus. Plantar reflex absent.

Left leg.—Cannot be moved at all as she lies in bed. The limb is extended and very rigid; attempts at passive movement cause pain. No flexion at hip joint. Foot over-extended and inverted. Below the knee the limb is oedematous, but there also seems to be some slight muscular wasting. There is complete anæsthesia and analgesia of the left leg extending up to a line about two inches below the patella. Knee-jerk exaggerated. No ankle-clonus; the extreme rigidity probably preventing its manifestation. Plantar reflex absent.

Muscular sense.—At hip good. At knee and ankle cannot be tested owing to rigidity. Knows when attempt is being made to bend the knee. First toe no sense of position, and also complete anæsthesia; other toes sense of position good, and tactile anæsthesia is in them only impaired.

Electrical examination.—Anterior tibial and calf muscles act to faradic current of same strength as that which causes those of the opposite side to contract. Peronei act to faradism, but require a distinctly stronger current than those of opposite side. Galvanic reactions of all muscles normal.

Back: some tenderness over lumbar spines.

Heart and lungs: no abnormal physical signs discovered.

The patient was ordered to remain in bed; to take Syrup. Ferri Phosph., ʒj., ter die, and Pot. Bromid, gr. xx., om. nocte, until she slept more soundly. After a few days of observation, during which the



patient's condition underwent no change except that the œdema of the foot and leg gradually diminished, she was ordered faradisation and the wire brush daily to the left leg, and three sulphur baths a week. The latter caused some faintness, so that on Nov. 14 they were replaced by electric baths three times a week.

Under this treatment the patient soon slept better, and the sensibility of the left leg gradually improved from above downwards; the rigidity of the limb also diminished at the hip and knee, though it remained unaltered at the ankle joint. On Nov. 21 she was, therefore, ordered daily passive movements and massage of the affected lower extremity; and on Dec. 7, as her appetite continued to be very poor and she was still anæmic, she was ordered to take Ferri et Ammon. Cit., gr. iv., Liq. Arsenical., ℥ iii., Liq. Strychn. ℥ iii., Sp. Chlorof. ℥ x., Infus. Gentian. Co. ad 3j., three times a day. About this time also she again began to have sulphur baths instead of electric baths, three times a week.

After this she remained in much the same condition for many weeks till towards the end of February, when she regained some power in moving the left leg at the hip and knee joints. A note made on Feb. 29 says:—"Left knee can now be raised and bent in bed, but left foot remains still in same position."

March 10.—Statical electricity daily was ordered; sparks to be taken from the leg and foot.

March 21.—The patient's condition being about the same, a hypodermic injection of Morphia (gr.  $\frac{1}{5}$ ) at the dorsum of the foot was ordered to be given every night at bedtime.

March 28.—Can move toes of left foot to-day. Ankle decidedly less rigid, and movements of knee much more free. (This improvement did not begin till two or three days after the hypodermic injections were commenced.)

April 11.—Improvement maintained; but has not increased much since last note. Ordered a daily subcutaneous injection of Aq. Puræ, ℥ ii. over calf of left leg.

April 25.—No further distinct improvement. Ordered a hypodermic injection of Liq. Atropinæ (gr.  $\frac{1}{80}$ ) every night, over the dorsum of the foot.

After this date she slowly but pretty steadily improved.

May 28.—The varus is now almost gone, but there is still much equinus. She can walk alone on the balls of toes (left foot), and does not use crutches at all. Tactile sensibility and sense of locality now very accurate all over left foot and leg. Electrical reactions.—Right leg: reaction to faradic current much diminished in all the muscles. Galvanic reaction normal. Left leg: faradic reactions



much diminished especially in peronei, which are also slightly wasted. Galvanic reactions normal.

June 19.—Can now walk very fairly well without stick or crutches, and gets heel pretty firmly to the ground. Still impaired dorsiflexion at ankle, however. Hypodermic injection to be suspended.

June 28.—During the last week she has gone out for short walks, and continued to improve in her power of walking. Looks much better than when admitted: is plumper, no longer anæmic; has a good appetite; sleeps well; and the catamenia are regular. During the whole time of her stay in the hospital no ordinary hysterical symptoms or manners have been noticed. Discharged.

This was a typical case in many ways. The monoplegia was preceded by a functional affection of the knee joint. For the first five months that she was in the hospital she only improved to a trifling extent; and her condition had at last become almost completely stationary. A marked improvement, however, set in after the subcutaneous injections of morphia were commenced on March 21, in the region of the ankle joint; and the improvement was subsequently increased and continued when atropine was substituted for the morphia. There was a complete absence of anything like hemianæsthesia; there was no appreciable loss of muscular sense in the affected limb; and the patient's mental condition was placid and equable, showing no exaggerated emotional manifestations. I think the case is, therefore, to be regarded as one due to spinal rather than to cerebral defect, and it is the last case I have to record belonging to the spastic type.

(B) CASES OF THE FLACCID TYPE, DUE TO FUNCTIONAL DEFECT  
IN THE ANTERIOR CORNUA IN CERTAIN SEGMENTS OF THE  
SPINAL CORD.

In this class of cases we have to do with a paralysis of flaccid type unassociated, it may be, with any affection of sensibility, and notably without any diminution of muscular sense. In other of these cases, where the functional defect is more diffused over the grey matter rather than limited to the anterior cornual regions, there may be a more or less marked impairment of common modes of sensibility, and



possibly also some amount of diminution of muscular sense, owing to interference with its afferent channels.

It may, perhaps, be assumed that the functional defect in the anterior cornua of the cord is adequate to bring about a more or less definite paralysis, even though the defect may not be sufficiently severe to entail any special muscular atrophy with development of the "reaction of degeneration."

The first case to be detailed seems to be a typical one of the simpler form of this kind of functional affection, in which there is well-marked motor paralysis without any marked sensory defect, and an almost complete absence of all ordinary hysterical concomitants.

CASE 18.—Emily E. R—, aged 21, was admitted into the National Hospital for the Paralysed and Epileptic, under my care, on Sept. 13, 1889. (Dr. Risien Russell, and Dr. James Bird, Cl. Cl.)

The patient was healthy enough till May last; she then suddenly lost her voice, and a few days later she lost the use of her legs. There was, so far as her mother was aware, no previous feebleness. She had had a good deal of very worrying work immediately before. She was a nursemaid, and had had charge of a "very troublesome baby." She has remained in much the same condition ever since last May, though she has been getting gradually more and more powerless. No sickness, but occasional headaches.

*Previous history.*—Always healthy; diphtheria three years ago; measles in childhood; no rheumatism; no scarlet fever; no fits of any kind; not excitable; catamenia always regular. Immediately before illness had no love affair or disappointment of any kind, so far as is known.

*Family history.*—Father died twelve years ago of typhoid fever; mother alive and healthy. One brother and two sisters, all healthy. One sister died of typhoid, and another of scarlet fever; a brother died at 31, in an asylum, of religious mania. No other history of nervous or mental disease.

*Present condition.*—A well-nourished girl, complaining of loss of power in both legs, so that she is unable to walk.

*Face.*—No asymmetry; movements equal on the two sides. Tongue protruded straight. Eyes: pupils equal, and react normally; no ocular paralysis and no nystagmus. Hearing good and equal.

*Arms.*—No loss of power; all movements carried out freely, without tremor or inco-ordination of any kind.



Spine.—Very slight lateral dorsal curve, with convexity to the right.

Lower extremities.—No undue wasting. Sensibility to light touches blunted, but feels slight prick of pin as such. As she lies in bed there is practically no power of moving either leg. She occasionally moves the toes of one or other foot very slightly; and when the knee is semiflexed passively there is some attempt to keep it so for a few seconds. There is no rigidity of either leg.

Gait.—Does not attempt to walk, and cannot even stand without very firm support. Is quite limp, and wobbles about as if she had no backbone.

Reflexes.—Left plantar greater than right; knee-jerks present and equal, rather less than normal; no ankle-clonus.

Organic reflexes normal.

Heart and lungs: nothing abnormal. Liver and spleen: no enlargement. Menstruation regular: no ovarian tenderness. Urine: nothing unnatural.

Occasionally suffers from globus. No aphonia now.

She was ordered Mist. Quinæ,  $\bar{z}$  i., ter die, with Pulv. Glycer. Co.,  $\bar{z}$  i., p. r. n; also faradism to the leg muscles, together with the wire-brush to the skin.

Nov. 11.—Ordered a tepid needle bath three times a week.

Dec. 9.—[As only a slight improvement had taken place in the patient's condition during her stay in the hospital up to this time, and as the case was rather a peculiar one, her "present state" was again taken at this date by another careful observer, Dr. Bird, who was at the time acting as my clinical clerk.] Patient is a healthy-looking and well-nourished girl. She complains of loss of power in her legs, and of pain in the lumbar region of the back, which comes on when sitting up or attempting to walk.

Face.—No asymmetry; movements good and equal on both sides. Eyes.—No ocular paralysis, ptosis, or nystagmus; pupils equal; medium, react to light and to accommodation. Acuity of vision good. Hearing good on both sides. Nothing abnormal about functions of fifth nerve, sensory or motor. Tongue protruded normally: no wasting, slightly tremulous. Nothing abnormal about palate.

Upper extremities.—No subjective sensations; tactile sense normal, also pain sense; muscular sense normal as to sense of position of arms, also as to appreciation of weights and direction of movements, eyes being closed. Movements good at all the joints; dynamometer, R. 55, L. 45. Slight tremor in left hand when held out. Triceps and wrist-jerks present and equal on both sides.



Lower extremities.—No subjective sensations. Tactile and pain sense normal. Muscular sense normal in all respects. Can move the toes slightly on both sides; can flex the ankles to some extent, but feebly; can also bend the knees and hips (when lying), but not against any amount of force.

Gait.—In attempting to walk she does not lift the legs; she pushes forward the right leg with the toes pointing forwards, and drags the left leg after, the foot being everted, with the toes pointing strongly to the left. If one straightens and brings the left leg forward she falls.

Reflexes.—Plantar reflexes not elicited on either side; knee-jerks well marked on both sides; ankle-clonus not obtained on either side. No rigidity of muscles.

Trunk.—Tactile sense normal. Epigastric and lower abdominal reflexes very active on both sides. Spine.—Dorsal curve, very slight convexity to right. Complains of slight pain over lumbar spine, not much aggravated by tapping.

Jan. 20, 1890.—Has been gradually improving, but still walks very badly, the left foot being dragged along the ground with the toes everted. Otherwise the patient is perfectly well; and when in bed all the different movements of the legs are now carried out well and with fair power. Knee-jerks remain active; no ankle-clonus; plantar reflexes difficult to obtain, but they were tried one day this week whilst the patient was asleep, and were found to be active.

Feb. 15.—Since last note was made improvement has been slow but quite distinct. Patient now walks with a peculiar swing—a sort of rhythmical lurch, first to one side and then to the other. Each foot is now raised from the ground, the right better than the left. With the latter there is still a tendency to drag. Has been still treated by faradism and the application of the wire brush to the legs, together with tepid needle baths.

March 18.—Patient is now able to walk with very slight impairment of ordinary gait. She lifts and lays down her feet in a peculiar, deliberate way, and her walk in consequence is slow and jerky. There is no anæsthesia. The knee-jerks are active and there is no ankle-clonus. Her general health is excellent. She was discharged, and sent to the Convalescent Home at Finchley for a few weeks.

June 2.—The patient came to see me at the hospital to-day, when I found her well in all respects, and walking quite naturally.

This, as I have said, seems to me to be a typical case of flaccid functional paralysis of spinal origin, occurring in a



comparatively healthy girl without hysterical antecedents of any kind except a loss of voice two or three days previously. Evidence of a neurotic history was also almost wanting. The onset of the paralysis was, if not abrupt, rapid ; though it did not reach its full intensity for some little time. It had lasted about four months at the time of the patient's admission, and it was not till she had been treated for over three months that any very perceptible improvement in her condition showed itself. She was a quiet, matter-of-fact girl, not at all emotional, or apparently exaggerating in any way her disabilities. The paralysis was flaccid throughout, and disturbances of sensibility were practically absent. Her muscular sense seemed to be normal in all respects. There was no wasting of special muscles, and though no distinct statement is made in reference to this point in the notes, I know the electrical reactions were found to be normal, or nearly so. The muscles reacted to faradism, but whether quite naturally I am unfortunately unable to say.<sup>1</sup> Her recovery was perfect, although it was brought about very gradually over a period of more than six months.

The healthy appearance of this girl was rather striking and unusual, and to a less extent it existed also in a somewhat similar case, occurring in a younger girl, of which the details are subjoined.

CASE 19.—Kate S—, aged 14, was admitted into University College Hospital under my care on Oct. 14, 1886. (Dr. Rüffer, and Dr. P. D. Turner.)

*Previous history.*—Having previously been a strong and active girl, she suffered from an attack of measles five months before admission. After this illness she found it necessary to have the support of an arm or of a stick when walking ; but soon got well enough to walk on level ground without assistance. Often when she tried to go down hill the left knee would give way under her. About the end of July (two and a half months ago) she went to Weston-super-Mare, and after she had been there about a week her right leg also became weak and gradually got worse. During the same time the patient's back became weak, and if she attempted to straighten it when standing she fell backwards. Any attempt to

<sup>1</sup> More details are, however, given in reference to Case 21. (See notes of June 5 and Nov. 25.)



straighten the back even when sitting up in bed similarly caused her to fall backwards. In the month of August she was brought to London and placed under medical care, but notwithstanding all treatment she continued to get worse, and was in consequence admitted to the hospital.

There were no points of any significance in connection with her family history.

*Present state.*—She is a fairly healthy looking girl, having the appearance of being rather older than her actual age. She is slightly anæmic. No defect can be recognised in the functional activity of the cranial nerves, sensory or motor. Patient's mental condition shows nothing unnatural; and she is not unduly emotional.

There is no wasting of muscles. She can lie in bed in any position. She can move her arms in all directions, but the movements are slightly jerky, and there are also slight tremors of both arms. Dynamometer, R. 20; L. 15. She can only sit up in bed when supporting herself by her hands; when these are raised she immediately falls over, and generally to the left side. When sitting, thus supported, she soon gets tired, and her back remains curved with the convexity backwards.

*Lower extremities.*—When lying in bed she can bend both knees and move her toes. She can also flex and extend the hip joints and can push her feet with considerable force against the observer's hands. When first put upon her feet her knees bent, and she almost fell backwards. But when her knees were kept straight she could walk with firm support, putting each foot down on its outer border.

*Sensation to touch, pain, and differences of temperature* was found to be natural everywhere over limbs, trunk, face, and head. All the muscles of the arms and legs react to the weakest faradic currents. There is no loss of muscular sense in the lower limbs; with eyes closed she knows the position in which they are placed. Under similar conditions she touches the tip of the nose readily with the forefinger of either hand. She can also pick up a pin perfectly well with either hand.

*Reflexes.*—Plantar exaggerated on both sides, knee-jerks slightly exaggerated on left side; ankle-clonus absent; abdominal and epigastric exaggerated on both sides.

Patient sleeps well; and her appetite is good. Pulse 105, full and regular. Temperature varies between 99° and 101·2°. Urine normal.

All the thoracic and abdominal organs seem to be healthy. The catamenia commenced two years ago, and have been quite regular ever since.



The faradic current was ordered to be applied to her leg and back muscles daily.

Nov. 10.—The patient remains in almost exactly the same condition; she is still unable to walk, and cannot support herself in the sitting posture without assistance. She is now being treated with sulphur baths three times a week in addition to the faradism; she has also been ordered *Pil. Ferri Sulphat.*, gr. v., *ter die*.

Nov. 20.—Patient is now suffering from a slight attack of bronchitis, and a few râles are to be heard over the base of each lung. Her cough is rather violent at times. Ordered *Mist. Ammon. c. Ipecac.* 3j, *ter die*.

Nov. 30.—The slight bronchitis has now disappeared. The faradic current is being continued, but the patient is to have a tepid needle bath in lieu of the sulphur bath three times a week. She is also taking *Ol. Morrhuæ*, 3j., *bis die*, with the sulphate of iron pill.

Dec. 7.—As no very distinct alteration seemed to have taken place in the patient's condition, she was submitted to a complete re-examination by a new house-physician. (Dr. Philip D. Turner.)

The patient reads nearly all day, and appears to understand and remember what she reads; but she takes little interest in what is going on in the ward, and rarely speaks. This appears to be due to apathy and reticence rather than to any mental deficiency. She answers all questions rationally but shortly. The functions of the cranial nerves were found to be normal in all respects. She sleeps well. She states that she has occasional frontal headaches. There is no spinal tenderness or actual curvature, but the back becomes, as before, much curved when she is supported in the sitting posture.

Upper extremities.—Movements at all joints are natural and fairly powerful. Grip: R. 45, L. 35. When squeezing the dynamometer hard there is a jerky movement of the trunk, neck, and opposite arm, instead of a rigidity of these parts such as would occur in a healthy individual.

Lower extremities.—Power of movement exists at all joints. If asked to kick up at an object placed about twelve inches above her toes she raises the foot briskly for the first part of the distance, but it then sways and jerks about for a moment before it succeeds in reaching the object. In trying to bend the knee against resistance, there is a slight amount of jerkiness and unsteadiness in the movement; and this is equally marked on the two sides.

Trunk.—She has some difficulty in rising to a sitting posture, but when this is once done the position is maintained by leaning the body forwards and propping herself up by resting the forearms on



the thighs. When the support of the arms is removed she falls over to the one or to the other side. There is nothing abnormal about the movements of the neck.

Gait.—The patient cannot stand or walk alone. If left entirely to herself she falls down at once in a heap. If she is firmly supported under both armpits and, in fact, half carried, she can take slow, feeble, and short steps with some difficulty; but when the hold is relaxed in the least degree her knees give way and she falls at once. In the steps which she takes (which are seldom more than six inches in length), the feet are not lifted off the ground at all, but are pushed or dragged along the ground on their outer edges, more by a swaying of the pelvis than by direct action of the muscles of the leg. The legs often get crossed.

Muscular sense.—The eyes being shut, patient can touch her nose with either forefinger, at once and with ease. She can pick up a pin with either hand without any difficulty. She can place either limb (upper or lower) in any required position with the eyes shut; and under similar conditions she can imitate with either limb the position in which the other is placed for her.

Sensibility to touch, to the prick of a pin, to heat and cold, perfect all over the body and limbs. The seat and nature of the stimulus are always correctly stated. The prick of a pin seems to be felt rather more acutely than natural over both legs.

Electrical reactions.—All the muscles react readily to the weakest faradic current.

Reflexes.—Plantars readily obtained. Abdominal somewhat excessive on both sides. Epigastric normal. Knee-jerk more marked on left than on right side, but not excessive. No ankle-clonus on either side.

The sphincters act normally.

Organs of the chest and abdomen uniformly healthy.

The same treatment to be continued.

Jan. 14, 1887.—Patient seems to be getting much stronger, especially in the muscles of the back, being now able to sit up in bed without the support of her arms. Her power of walking has also improved. She is taken round the ward every morning, and is able to walk with rather less support than at first. Her general health is very good.

Jan. 22.—Patient walks a little better, with slightly less support. Every time the right foot is put to the ground it is inverted, apparently by muscular spasm. All the time she is walking the extended left arm is jerked spasmodically, as though there were some extension to it of the effort to keep herself upright. Knee-jerks



exaggerated on both sides just after walking around ward. No ankle-clonus.

Jan. 27.—Walks very much better to-day, requiring very little support compared with what she did formerly. She walked a good deal with her mother yesterday in the ward, and seemed to do so better than usual. She has been having faradism again lately to the back and leg muscles.

Feb. 5.—The right ankle is getting stronger, and does not become inverted so much when she tries to walk. Faradism is continued, and she still has a needle bath on alternate days.

Feb. 15.—Patient can walk now with much less support, but the right foot is still distinctly inverted, and she does not seem able to place her feet firmly and flatly on the ground, the toes being often turned up.

Feb. 26.—She now manages to get about the wards with the support of an arm-chair, pushing it before her. She can also walk round the ward supporting herself by the beds as she passes.

Feb. 28.—After exercising with the arm-chair, patient is now able to walk from one end of the ward to the other and back without any support. Her gait is still very uncertain, and she seems to have to call all the muscles of her body into action in order to maintain her equilibrium.<sup>1</sup>

March 9.—Patient has been steadily improving since the last note, and walks now almost without staggering.

March 11.—Discharged, practically well.

It is worthy of note that during the whole of the time this patient was in the hospital, even up to the last, her temperature at 6 P.M. was found to be about one degree above the normal.

Whatever the pathogenesis may have been, the morbid phenomena met with in this case were very simple, and very similar to those met with in the last case. There were practically no sensory defects; not even the pains or tenderness in the back which are so common; though the weakness of the trunk muscles was distinctly more pronounced than it was in the case of Emily E. R.—.

In the case just recorded, the motor disability seemed to have been related to a previous attack of measles; just as, in one now about to be detailed, a much more generalised paresis showed itself after an attack of influenza. Here a

<sup>1</sup> The same kind of thing was seen in Case 22, when the patient began to walk about alone. (See Notes of April 18 and May 5, 1890.)



condition of almost complete powerlessness had existed for about eighteen months before the patient came under my observation, but she completely recovered in the course of rather more than four months, not only from the motor defects but from various well-marked sensory defects and troubles.

CASE 20.—Lydia W——, aged 26, was admitted into University College Hospital on Feb. 20, 1892. (J. E. Paul, M.B.)

*Previous history.*—Rather more than four years ago the patient had a first fit. These attacks gradually became more frequent till she had as many as seven or eight a day. This frequency continued for about two years, when it gradually diminished, till she had on an average only about one a week. The fits are described as varying in duration from half an hour to three or four hours. She says she usually knew when they were coming, as they were preceded by a “funny feeling” all over her, but she never had any distinct local sensation. She never cried out before the fit began or during its progress. They occurred at all times of the day, and she sometimes fell in them while in the streets. Never micturated or bit her tongue during a fit.

About eighteen months ago she took to her bed on account of a weakness that came over her. It was not confined to one side or to the lower extremities, but is described as general. This weakness gradually increased until she became quite unable to do anything for herself: she could not wash herself, feed herself, sit up in bed, or move either of her limbs. During this time the fits gradually left her, and she then began to suffer from intense headaches. The pain was and is felt all over the head, but is described as most severe in the occipital and frontal regions. She also suffered from great pain in her back, and occasionally from pains in her limbs.

Patient cannot account for the onset of the fits, unless they were due to a fright she had seven years ago, when an assault was made upon her by a near relative. For some time after this she was also much distressed, owing to her father taking to “drink,” and losing his employment. (Eventually she was adopted by some friends, who have taken care of her ever since.)

She says she has had three attacks of influenza: in Jan. (?) 1890, Dec. 1890, and in Dec. 1891. (This would put the onset of the great weakness somewhere between the first and the second attack of influenza.)

Catamenia regular till eleven months ago, when she had amenorrhœa for seven months; of late she has been quite regular again.



There is no neurotic family history, and she has four brothers and sisters who are alive and well.

*Present condition.*—The patient is an anæmic girl, looking younger than her real age. Her countenance does not betoken pain or severe suffering. No ocular paralysis. Pupils equal, reacting to light and accommodation. No nystagmus. The functions of all the cranial nerves, in fact, seemed to be unimpaired.

She complains of headache, backache, and of a pain in her left side. She is unable to turn herself in bed, or to sit up, even when propped up. She cannot feed herself, owing to her weakness. She is unable to flex her hips or knees, or raise the legs from the bed; but she can move her toes and hands. Grip: R. 20; L. 20. There is a general paretic condition, but this is not more marked on one side than on the other.

*Sensory system.*—The muscular sense is good everywhere. There is no diminution of sensibility to painful impressions, or to heat and cold. Sensibility to tactile impressions is diminished over the outer side of the right calf, and over the left calf more posteriorly. There is also some diminution over the outer and middle part of left thigh. No impairment was found elsewhere. Localisation good. Marked hyperæsthesia exists all down the spine, most pronounced in the interscapular region, at the angles of both scapulæ, and also in each mammary region.

*Reflexes.*—Pharyngeal diminished; scapular and abdominal exaggerated; plantar not obtained. Elbow- and wrist-jerks present; patella exaggerated; ankle-clonus not obtained. Sphincters act normally.

*Electrical reactions:* these are normal, all the muscles reacting to the faradic and constant currents.

*Thoracic and abdominal organs:* nothing unnatural except that she suffers from marked constipation.

Was ordered massage and faradisation of the limbs and back muscles on alternate days; also to have a sulphur bath three times a week, and to take the following medicine:—Ferri et Ammon. Cit., gr. v.; Liq. Arsenical., ℥ iii.; Liq. Strych., ℥ iv.; Infus. Gentian. Co., ad ʒj, ter die. Full diet.

March 1.—Patient was yesterday propped up with pillows and the bed-rest for two or three hours, but was very tired afterwards. She complains of the pain in her back and head very much. Takes her food better, and sleeps well.

March 7.—Still complains of the pains. Constipation obstinate. She can now flex her legs at the hips and knees with some force; and do a little knitting. She also feeds herself. She sits up in bed



a little every day, but soon complains of being tired. In addition to the faradism to the limbs and back muscles, she now has the constant current run through the spine daily.

March 21.—Patient does not complain so much of pains in the back, and seldom has headaches. She sits up in bed twice a day, supported by pillows. She can draw up her legs better, and can now turn over in bed with very little help.

March 24.—The hyperæsthesia over the spine which had diminished considerably during the last fortnight is found to be increased this morning, the slightest touch causing marked reflex action.

March 28.—Patient was carefully tested this morning for alterations in sensibility. In right foot, over first, second, and third toes, and also over plantar surface just posterior to these toes, there is loss of tactile sensibility; it is also impaired over the other two toes. In the left foot sensibility is lost over the terminal phalanges of all the toes, and also over the anterior half of the plantar surface. Sensibility over the dorsum of both feet and around the ankles is good. The patches of anæsthesia over the calves of the legs have now completely disappeared; and over other parts of the body no defects of sensibility could be recognised. The patient still winces when pressed under the left mammary region, though the tenderness here is very much less than it was at first; and it is almost completely lost under the right mamma. Along the spine the hyperæsthesia has diminished very much, but it is still present, and the scapular reflex is very readily obtained.

April 21.—The anæsthesia of the right foot has rather increased; it now reaches half way over the dorsum of the foot. Patient's general condition is better; she has less pain in her back, and she sits up every day for an hour or two. The massage and the use of the batteries are continued as before.

May 16.—Patient is looking much better; her aspect is brighter, and she answers questions less languidly. Her face is also fuller and of a better colour. The hyperæsthesia of the back is less marked, but it is still most pronounced between the scapulæ. The hyperæsthesia of the mammary region has completely disappeared. The anæsthesia of the feet remains about the same.

May 22.—The anæsthesia of the left foot has completely gone, though it still persists in the right foot. Otherwise patient is in about the same condition, except that she sits up rather better. She has gained four pounds in weight during the last two months.

May 25.—There still remains slight anæsthesia over the first and second toes of the right foot, otherwise the defects of sensibility



have completely cleared up. With the aid of a nurse, patient yesterday walked round the ward for the first time. She is generally much brighter. She eats and sleeps well. Knee-jerks normal.

May 31.—Says she feels very well. Has completely lost all her aches and pains. Sits up better, but still tends to fall to one side if left unsupported. Walks round the ward with the aid of the nurses daily.

June 6.—She sits up most of the day now and does needlework. Still practises walking, but this soon tires her. The anæsthesia has now completely cleared up, and the hyperæsthesia over the interscapular region is nearly gone.

June 18.—There has been a steady improvement since last note. She now sits up in bed most of the day without feeling tired, and gets out of bed in the afternoon. She does much needlework; and she walks with less help and more firmly. No anæsthesia or hyperæsthesia. Appetite good. Sleeps well. Has gained two pounds during the last month.

June 29.—Yesterday patient went out on to the green in front of the hospital, and walked about a little, and was not fatigued after it. She went again to-day and enjoyed it.

July 5.—For the last four days patient has been walking about unaided. She sits up all day without being wearied. Is gaining weight steadily. No complaint of pains or headache; no anæsthesia or hyperæsthesia. Knee-jerks normal. Menstruation regular. Discharged.

It seems very probable that the patient's paretic condition set in after the first attack of influenza, and may have been aggravated by the second attack occurring a few months after its onset. The pains in the back and head were altogether exceptional in their severity, and this may perhaps be due to the fact that the patient's general condition was a sequela of influenza. The fits from which she previously suffered were probably, judging from the details we were able to obtain as to their nature, of an epileptic rather than of a hysterical nature. It is worthy of note that this is the only one of my cases in which fits of any kind have occurred in association with the paralysis. There was no unduly emotional condition, or tendency to exaggerate her disabilities.

The next two are also cases of an exceptional order, inas-



much as the subjects belong to the male sex. In the first of them we have to do also with more of a mixed type, as rigidity was not absent, and there were likewise distinct sensory defects.

CASE 21.—Wm. M——, aged 13, was admitted into the National Hospital for the Paralysed and Epileptic under my care on March 1, 1889. (Dr. Risien Russell.)

*History.*—Patient was quite well till three or four months ago. He then had a bad headache, and could scarcely speak; apparently could understand what was said to him, but could not answer. Was in bed for ten days with an ice-bag on the head. Never lost his senses so far as he knows. At the end of ten days he spoke quite well, but was found to be paralysed on the right side; this was noticed just before he got up. His face was not drawn. No loss of control over sphincters; no pain in back.

Patient could stand when he got up, but could not walk; was prevented by weakness of the right leg. Remained ill in this way a fortnight or three weeks; then had a rash, which was pronounced to be that of measles by the doctor. No running at eyes or nose; no desquamation observed; nothing peculiar about urine. None of the other children contracted the disease. After this illness left him the right arm seemed to recover, but both legs were found to be affected; and he has never been able to walk since, or even to stand, though he has been otherwise well. No nausea or vomiting.

*Previous history.*—General health good. Had measles and German measles eight years ago; scarlet fever four or five years ago, and recovered from it well. Had “diphtheritic throat” four years ago; no consecutive weakness. No sore throat at commencement of illness. No accident; no knock on head. No rheumatism or chorea. Seems to have been paler than usual for last two years.

*Family history.*—Father and mother alive and healthy; five children, all healthy; patient is the second. One little girl died of diphtheria eight years ago. Mother had no miscarriages.

*Present condition.*—A pale, delicate-looking boy, complaining of loss of power in his legs.

Face: upper facial movements are equal, but on showing teeth left half of upper lip is not so well raised as right, and on smiling the right naso-labial fold is certainly better marked than the left. Eyes: pupils equal and react normally; no strabismus; no nystagmus. Optic discs normal. Hearing: on right, watch at two inches; on left, at six inches. Tongue protruded straight. Palate: two sides equal, and move equally; uvula in middle line. Tonsils enlarged.



Upper extremities.—Can carry out all movements, but the right arm is certainly weaker than the left. No rigidity of right arm. Grasps: R. 9; L. 18. Reflexes: those of triceps and wrist active and equal on the two sides.

Trunk.—No curvature of spine other than normal. No tenderness on percussion; no pain on movement. Reflexes: epigastric and lower abdominal active and equal; cremasteric present, equal. Organic reflexes normal.

Inferior extremities.—Some wasting of legs; considerable rigidity, most marked at knees, less at hips, but none at all at ankles. Patient is quite unable to stand. Cannot dorsiflex feet at ankles, but can move toes slightly. Can raise each heel slightly off bed (two inches) with very great difficulty; can scarcely draw knees up at all. Reflexes: Plantar not obtained; knee-jerks exaggerated, equal; ankle-clonus present on both sides, but sometimes difficult to obtain. Sense of position impaired; often gives wrong answers; cannot say what position great toe is in. Sensibility to touch and pain normal, except over both feet, where there is absolute loss, and for about four inches above ankles where there is considerable blunting.

Heart: sounds normal, no bruit; action regular. Lungs: nothing abnormal detected. Liver and spleen: no evidence of enlargement. Urine acid, sp. gr. 1022, no albumen, no sugar.

March 11.—All the muscles of both lower extremities respond well to the faradic current. He has been taking since admission Mist. Quinæ,  $\frac{3}{4}$  i., *ter die*; is to continue with this, and to have the faradic current and massage daily to the lower extremities, together with a warm brine bath on alternate days.

March 26.—Ordered Syrup. Ferri Phosph. et. Ol. Morr. aa  $\frac{3}{4}$  j., *ter die*.

April 15.—Wire brush to feet daily; faradisation of leg muscles to be continued, and also the brine baths.

June 5.—There has been scarcely any alteration in his general condition. The muscles of the lower extremities all respond to faradism, but require a very strong current, and the resulting contraction is slow, and not at all as in healthy muscles. To galvanism, however, K. C. C. is greater than A. C. C.

Oct. 14.—Motor power has been improving during the last fortnight. He can now draw up his knees and raise extended legs off bed very fairly. Moves toes slightly; but dorsiflexion at ankles is still practically *nil*. "Sock anæsthesia" persists. Knee-jerks excessive on both sides; ankle-clonus at present not obtained on either side.



Nov. 25.—He can now walk, though there is still next to no power of dorsiflexion at the ankles. Muscles respond tardily to faradism, but to galvanism K. C. C. is greater than A. C. C. "Sock anæsthesia" still present, though not nearly so absolute. Pseudo-clonus has varied from time to time. No clonus of any kind now. The legs are wasted as a whole, no special groups being affected. The left grasp is still slightly greater than the right; but both are much more powerful than they were on admission.

Dec. 22.—Power of walking continues to improve, but there is still next to no power of dorsiflexion of feet. "Sock anæsthesia" almost gone. Knee-jerks active; no ankle-clonus. Discharged.

Feb. 3rd, 1890.—Patient came to hospital to-day. He had not been able to come before owing to an attack of influenza. He walks very much better, and although there is still distinct evidence in the gait of weakness of the anterior tibial group, there is nothing like the amount of "drop-foot" there was when he left the hospital. When standing with the heels together he can raise his toes off the ground, keeping his heels on the ground very fairly, and this movement is still better carried out when he is sitting. Patient can dorsiflex still more when the legs are resting on something, and extended straight in front of him, but the movement is carried out in a tremulous, irregular, uncertain manner. No sign of "sock anæsthesia" now; feels as well on foot as over upper part of leg.

Reflexes.—Plantar present, slight; knee-jerks not easy to elicit; no ankle-clonus.

The early history of this case, as given by the patient and his friends, is altogether obscure and difficult to interpret. He seems at first to have had some cerebral attack in which the right limbs became paralysed. This, in the course of a week or two, was followed by an illness said by the doctor to have been measles, after which the power in both legs was found to have been lost, and the boy is said to have remained in much the same condition for the six or eight weeks preceding his admission to the hospital. Notwithstanding all the careful treatment he received, no definite sign of improvement was noticed till after he had been in the hospital for a period of seven months. Improvement in motility set in first, though after about a month this was followed by distinct improvement in the limited, sock-like anæsthesia. All the movements of the lower extremities were distinctly impaired, though those of the toes and ankles were almost completely



lost. The anæsthesia was absolute over the feet (including slight impairment of the muscular sense), and less marked for a short distance above the ankles ; elsewhere being normal. It seems most likely that the limited impairment of the muscular sense was due, as with other modes of sensibility, to implication of afferent channels ; certainly there was no error in the localising of touches such as is met with in cases of cortical type ; and there was nothing like hemianæsthesia on either side to indicate that the mixed paralysis in this case was of cerebral origin.

Here there is recorded a distinct departure from the normal response to faradism on the part of the affected muscles ; and that the nutrition of the cells in the anterior cornua was markedly affected seems indicated also by the very slow way in which recovery was brought about.

The next case is one that is still more strange and interesting than the last. It is also a case of mixed type, sensibility being extensively involved. It will be found that there are some resemblances between this case and Case 10 ; only here we have a flaccid instead of a spastic form of paralysis.

**CASE 22.**—Alfred N——, aged 13, was admitted into the National Hospital for the Paralysed and Epileptic, under my care, on April 1, 1889. (Dr. Taylor and Dr. Risien Russell.)

*Previous history.*—Says he felt weak in his legs for some months in the beginning of last year. Had pleurisy in the following April ; was ill in bed, and was blistered and poulticed on the left side. After recovery he found himself unable to walk, and this disability has continued ever since. His legs shake much when he stands on them, but do not jerk or shake as he lies in bed. He has no pain in the back, but great weakness, and is unable to sit up. No girdle sensation ; no trouble with sphincters.

*Family history.*—Father and mother healthy. There are seven in the family, of whom the patient is the second. All healthy ; no tubercular history.

*Present condition.*—A somewhat pale and delicate-looking boy, with loss of power in the legs. Pupils equal ; react to light and to accommodation. No ocular palsy ; no nystagmus. Optic discs normal. Movements of the face not very strong. No inequality on the two sides. Tongue protruded straight. Palate moves equally.

*Upper extremities.*—Patient says they feel weak, but there is no



paralysis of any movement. Light touches are felt and localised correctly. He says that his fingers occasionally feel numb; not more in one hand than in the other. Elbow-jerk and wrist-jerk slight, and equal on the two sides.

Lower extremities.—Light touches are felt and accurately localised on both feet; between ankles and knees touches are felt, with some hesitation, and usually he is unable to say where the touches are, but at other times they are accurately perceived and localised. Above knees, sensibility to touch seems fairly acute. Slight blunting to painful impressions seems to be present below the knees. Hot and cold test tubes are distinguished everywhere. Motor power.—Slight power of movement in toes, about equal on the two sides. At the ankles also there is slight power of dorsiflexion and extension. The knees are just moved and nothing more; no attempt at flexion. At the thighs there is slight power of abduction and adduction, and of internal and external rotation.

Reflexes.—Knee-jerks exaggerated and equal; no ankle-clonus, but apparently a tendency to it. Plantar, cremasteric, abdominal, and epigastric reflexes all present and equal. Organic reflexes normal. Spine: marked tenderness of first and second dorsal vertebrae. No tenderness on percussion, or on movement of the head in any direction. Chin can be depressed without causing any pain.

Heart, lungs, and abdominal organs: nothing unnatural discovered. Urine acid; sp. gr. 1024; no albumen. Ordered Syrup. Ferri Iodid.,  $\text{ʒi}$ , ter die, and Pulv. Glycyrrhizæ Co.,  $\text{ʒi}$ , p. r. n.

May 7.—Incontinence of urine during the night when asleep, and also when awake in early morning. This has been noticed for the last few days. Ordered Ol. Morr.,  $\text{ʒi}$ , ter die; Acid Hydrochlor. Dil.,  $\text{ʒi}$  v.; Decoct. Cinchon.,  $\text{ʒss}$ , ter die.

June 3.—Motor power in legs less than it was. Legs lie extended; ankle dropped; no movements of toes, ankles, or knees can be carried out. There is now great impairment of sensibility, greatest in the legs, but extending up as high as clavicles; even on the chest only coarse touches can be felt. Incontinence of urine still continues. Ordered Syrup. Ferri Phosph.,  $\text{ʒiss}$ , ter die.

Aug. 8.—The patient's condition now is as follows. As he lies in bed the lateral excursions of the head on the trunk are carried out, but he is unable to raise his head off the pillow so as to bring the chin in contact with the sternum. Makes an excessive appearance of effort in trying to accomplish this movement, raising eyebrows and otherwise distorting the expression of the face. Is unable to sit up in bed without support, and when the trunk is supported the head flops in all directions, as if the neck were quite limp. He fails



to execute any movements of it except by letting it fall in this or that direction ; yet when the head is passively placed in a certain position, he, as a rule, keeps it there. The arms are quite free from paralysis, all movements being well carried out. The legs lie absolutely motionless in bed. The knee-jerks are active and equal ; no ankle-clonus. No increased resistance to passive movements. The anæsthesia has a peculiar distribution ; it exists all over the body, excepting in the hands and arms, the upper three-fourths of the face, and the whole of the head except the ears. Over the areas specified sensibility is quite normal. He now passes evacuations as well as urine in bed almost constantly.

Oct. 18.—Involuntary evacuation of bowels occurs occasionally. This condition came on soon after incontinence of urine became fully developed, and is worse now than it was then. He sometimes knows that his bowels are going to act and calls the nurse, while at other times he appears to be quite unconscious of it. The anæsthesia has been gradually clearing up from above downwards, so that he can now feel when the face, neck, or upper part of the trunk is touched, but not over lower part of trunk and legs. Now, and for some time previously, he has had no power of supporting the head when he is held up in bed ; it flops forwards or backwards owing to the complete flaccidity of the muscles of the neck.

Patient has been treated with the wire-brush over the anæsthetic parts since the end of July ; and since Sept. 16 he has been taking Kepler's Maltine  $\text{c. Ol. Morr.}, \text{3ij.}, \text{ter die.}$

Nov. 1.—Anæsthesia cleared away down to about the costal margin. Absolute anæsthesia below the umbilicus and over the legs ; but between the umbilicus and costal margin he sometimes feels slight touches, at other times does not. Head no longer flops in one or other direction now when he is raised in bed. The movements of the head on the trunk are also better carried out, though with an extreme show of effort to prevent the flopping. He twists his face into all sorts of contortions when making these efforts. His legs remain absolutely motionless. Reflexes continue unaltered ; no ankle-clonus on either side. Condition of sphincters remains much the same. Is still unable to sit up in bed without support.

Dec. 9.—Is anæmic. Ordered Ferri et Ammon. Cit., gr. v., Sp. Chlorof.,  $\text{m x.}, \text{aq. ad. 3i.}, \text{ter die.}$  Massage and faradism daily to legs and back muscles.

Jan. 18, 1890.—He is now very pale and anæmic, but is quite comfortable, and does not complain of pain anywhere. Head : no tenderness on direct percussion. Face : no affection of sensibility anywhere. Masseters and temporals act equally on the two sides,



and the lower jaw opens in the middle line. No facial asymmetry at rest or in action. Shows the teeth equally well on the two sides. Raises the eyebrows slightly, and closes the eyes fairly well. Cannot frown. All the upper facial movements are carried out with great show of effort and with production of considerable grimaces. Tongue protruded in the middle line. Palate: both arches equally drawn up on saying "Ah"; reflex brisk and equal; tactile sensibility normal. Neck: all four excursions of the head well carried out. Does not allow the head to flop in all directions as formerly. No blunting of sensibility on either side.

Trunk.—Back muscles are still weak, but he does not flop about in the same helpless way that he did formerly. When he is put flat on his face with his hands at the sides and he tries to raise himself by the back muscles alone, the episternal notch is raised six inches from the floor. The back muscles become tense during these efforts, but they are evidently wasted and wanting in bulk. When he tries to get up from the recumbent posture with his hands folded across the chest, he fails to do so, and though the abdominal recti stand out, yet they are not nearly so tense as in health, and are not capable of sustained effort. He is unable to sit up in bed without using his arms as supports. Trunk muscles respond well to faradism. There is now no affection of sensibility over the trunk.

Reflexes.—Epigastric and lower abdominal present, but left more brisk than right.

Upper extremities.—These are somewhat wasted. No blunting of sensibility anywhere. All movements well carried out, but slight tendency to tremulousness on left side, especially on trying to touch the tip of the nose with the forefinger, eyes being closed. Can bring the tips of the forefingers together in front of him, under similar conditions, quite well. Grasp: R. 35; L. 30. Reflexes of triceps and wrist present, slight, equal.

Lower extremities.—The legs are greatly wasted generally, not in special groups of muscles. No blunting of sensibility anywhere. Can just move toes slightly on both sides, and there is an occasional jerk of foot at ankle on attempts at movement at this joint. Can flex each knee to extent of raising the popliteal space three inches off bed. Unable to raise extended leg off bed. All movements much better performed when strong faradic battery is present to stimulate and assist; can then raise extended leg very slightly off bed, and keep it off the wire brush which is lying on the bed below the raised leg.

Reflexes: plantar present, equal; knee-jerks very active; ankle-clonus not present, and no tendency thereto. Organic reflexes: no difficulty in swallowing; complete control over sphincter ani for some



time; incontinence of urine only at night now, and that not often. Electrical examination: all muscles respond well to faradism, both directly and through the nerve. Add Liq. Arsenicalis and Liq. Strych.,  $\text{aa } \text{m } \text{ij.}$ , to mixture.

Feb. 3.—Can now move toes and foot at ankle much better. Range of movement in drawing up knee greatly increased. Can raise one leg so as to cross it over the other as they lie extended in bed. In trying to walk with the “go-cart” he can just drag the legs forward, scraping backs of toes.

March 31.—For the last month patient has been steadily improving in his walking. He can now walk alone with the “go-cart.” He lifts each foot equally well, and brings leg forward well, but has to bear rather on one side instead of holding himself erect when walking with the “go-cart.” His general health is excellent, and he is looking in every way much better.

April 18.—The boy has continued to improve since last note. Has only walked with the “go-cart” till to-day. This morning was made to do without it. He staggered about very much, but never fell even when pushed forward. Has great difficulty apparently in raising the toes from the ground, the feet being swung forward in a position of “drop-foot.” General health good.

May 5.—The patient has been walking daily since last note without the “go-cart.” Is able to walk fairly well; staggers about a little, but never falls. Still same disability in raising toes clear of the ground; gets up and down stairs with some difficulty. Keeps himself in a much more erect and natural attitude. No incontinence for last two months.

June 12.—The patient walks stiffly, keeping left leg extended at the knee. Says he has been walking too much. No swelling; no pain on pressure or passive movement; condition otherwise unchanged.

July 2.—The patient was put to bed after last note, and after a few days he could walk as he does now without any perceptible stiffness.

July 25.—On examination the patient is found to be able to walk naturally and without stiffness. Has no anaesthesia. Functions of bladder and rectum are normal. Knee-jerks active and equal. No clonus is elicited. General health is good. Discharged.

It will be perceived from the notes of this very remarkable case that the boy had been suffering from weakness of the legs for more than twelve months previous to his admission, and that from two to three months after its commencement, subsequently to an attack of pleurisy, the weakness had become



much accentuated. The paralysis of motion and of sensibility distinctly increased for some time after admission, and in the month of May incontinence of urine commenced, and was shortly followed by incontinence of fæces—both these disabilities continuing, strange to say, for about six months. This incontinence has, in exceptional cases of functional paralysis, been previously observed. Dr. Buzzard, for instance, in reference to this subject says:<sup>1</sup>—“The behaviour of the bladder has sometimes been made a crucial test in the question between functional and organic disease. It is quite certain that patients affected with hysterical paraplegia may suffer from inability to prevent discharge of urine into the bed.” I know of no other case of functional paralysis, however, in which there has been incontinence of urine and of fæces extending over such a prolonged period. Early in the month of August there was an absolute flaccid paralysis of the lower extremities, and a considerable amount of powerlessness also about the trunk and neck muscles, yet the knee-jerks were still active and equal, as they had been all along. There is, unfortunately, no distinct record of the electrical reactions at this period, though I feel almost certain that throughout there was good reaction to faradism. In the following January, when recovery of motor power had distinctly set in, and there was no longer anæsthesia either of trunk or legs, though there was great general wasting of the muscles of the lower extremities, the notes say that “all muscles respond well to faradism both directly and through the nerve.” And in reference to this point, it should be borne in mind that in some hysterical cases there has been observed a rapid general wasting of muscles without appreciable modification in the electrical reactions.<sup>2</sup> It will be observed from the notes of Oct. 18, and Nov. 1, that the anæsthesia began to clear up from above downwards, and before there were any signs of increase in motor power; early in January, in fact, the anæsthesia had completely disappeared even from the legs. It is worthy of note also that this boy’s weakness and paralysis had lasted for about one year and eight months before there was any

<sup>1</sup> *Brain*, 1890, p. 15.

<sup>2</sup> See Charcot, *loc. cit.*, pp. 391, 393 and 406; also Babinski in *Archives de Neurologie*, Nos. 34 and 35, 1886.



commencement of the recovery of motor power. And the fact that complete recovery did not take place for over eight months more may be taken as an indication of the grave extent to which the nutritional condition of the cord had become impaired, especially in the anterior cornua of the dorsal and lumbar regions.

#### CONCLUDING REMARKS ON DIAGNOSIS, PROGNOSIS, AND TREATMENT.

IN the foregoing pages I have made an attempt to break new ground by more definitely defining the various forms of hysterical or functional paralysis—referring the different varieties, that is, to departures from a natural nutritive state (and therefore to an altered functional condition) of this or that region of the brain, or of this or that anatomical system in the spinal cord.<sup>1</sup> I entertain the hope that this little book may stimulate observers to make a more careful scrutiny of the actual condition presented by those of their patients whose history and general state are such as to make them come to the preliminary conclusion that they have to do with cases of functional paralysis. If this be done the indications here brought forward as of importance in diagnosis will soon be either confirmed, improved upon, or replaced by others of more value. At all events, our knowledge of this important class of diseases can scarcely fail to be greatly increased by the more thorough and minute examination to which, for this purpose, they must necessarily be subjected.

**DIAGNOSIS.**—A review of the cases here detailed supports the notion, which I have many times expressed, that it is a great error to use the appellation “hysterical” as though it were synonymous with “functional.” As a matter of fact the former term is much narrower in its significance than the latter. The one may be said to have a specific, and the other a generic

<sup>1</sup> Cases that could be considered as instances of paralysis due to functional defects of peripheral nerves have not been met with by the writer, though it must not be forgotten that, according to Landouzy (*De l'Hystérie*, 1846, p. 127) and a few others, the causes of hysterical paralysis are to be found in minute alterations of the nerves and muscles in the parts affected rather than to any such changes in the brain or in the spinal cord.



value. There are, indeed, many forms of functional paralysis which cannot properly be classed as cases of hysterical paralysis, though this is a fact but too little recognised.

The opposite point of view is one which has held its ground doubtless in part because of the teachings of great masters, both ancient and modern. Thus, Sydenham tells us that when he had carefully examined patients, and had found their cases "difficult to be determined by the usual rules for diagnosis," and also that they were "worse sufferers when trouble, low spirits, or any mental perturbation takes hold of them," he considered the affection from which such patients were suffering to be a form of hysteria.<sup>1</sup> How dangerous and wholly unsuited for general adoption such a method would be, when had recourse to by observers whose knowledge and experience were less, and varied widely, I have already referred to.<sup>2</sup> Yet it cannot be denied that some such practice has been, and still is largely resorted to by many practitioners of medicine. No one in our day has striven with more success than Charcot to obviate the errors which must inevitably result from the adoption of any such method. He has laboured to give precision to the characteristics of hysteria, and has shown that in its developed form—that of "hysteria major,"<sup>3</sup> as he terms it—we meet with an assemblage of symptoms of a very definite character, entitling it to take rank as a distinct neurosis.<sup>4</sup> With all due deference, however, to so accomplished an observer, it may be urged that he pushes the conception of hysteria a little too far in his interpretation of certain cases as "masked or latent forms" of the disease,<sup>5</sup> when perhaps there only exists a strict warrant for saying that they are cases of functional apart from structural disease. I am not prepared to believe that every one in whom a cerebral hemianæsthesia exists in the absence of organic disease of the brain, or the poisonous influence of lead or alcohol, is to be regarded as an hysterical subject. Yet this is Charcot's point of view, and

<sup>1</sup> The Works of Sydenham (Sydenham Society), vol. ii., p. 90.

<sup>2</sup> *Ante*, p. 2.

<sup>3</sup> *Loc. cit.*, pp. 33, 278-83.

<sup>4</sup> One, however, which in anything like a complete form is only very rarely met with in this country.

<sup>5</sup> See, for instance, his interpretation of a supposed case of this kind (*loc. cit.*) on pp. 100-106.



when treating of contracture or paralysis he seems to consider that the appellation "hysterical" covers the whole ground of mere functional defect.

While, therefore, Charcot has done much to limit the use of the term hysteria, by having more definitely made known the various characteristics of which it is compounded (and thus rendered its diagnosis more certain), I would urge that the use of the word hysteria should be still further limited, and that we should strive to come to some agreement as to the nosological value of certain of its component symptoms, and as to the proportion of cases of functional paralysis which should rightly be termed "hysterical."

I am myself inclined to believe that not more than about one half of such cases are to be regarded as instances of hysterical paralysis. The modern conception of hysteria, that of Briquet,<sup>1</sup> Charcot and others, is that it is a neurosis due to perversion of certain brain functions. If, therefore (this view being correct), all the cases of functional paralysis of cerebral type were in future to be styled "hysterical," it is obvious that nothing further could be legitimately claimed even by those who are most prone to invoke hysteria when diagnostic troubles confront them. But, in my opinion, even this would be going too far. Only some of the cases of cerebral type should, I believe, be so designated, though the grounds on which such a division of the cases of cerebral type is to be based cannot as yet be definitely formulated.

If, on the other hand, I have made good the claim to show that there are many other cases of functional paralysis which depend rather upon a perverted functional activity of the spinal cord, the suggestion at once arises that this whole group of cases should not be regarded as hysterical, and that we may more correctly speak of them simply as cases of "functional paralysis."<sup>2</sup> An examination of the details of the cases presumed to be of this type will I think show, moreover, a striking absence of most of the characteristic

<sup>1</sup> *De l'Hystérie*, 1859, pp. 601-604.

<sup>2</sup> It would be more correct, of course, to use the word "functional" only as a wider term, including under it the hysterical and also the non-hysterical cases, but no good term at present suggests itself to me as a suitable appellation for these non-hysterical cases.



features of hysteria. Thus, in addition to the differences to which I have already called attention, there is an absence in these cases of spinal type of fits or attacks of any kind,<sup>1</sup> together with an absence of any tendency to exaggerate disabilities, as well as a similar absence of those "caprices of mind and temper" which are so commonly met with as constituent elements of the hysterical neurosis.

It may be useful for me to give here a brief enumeration of the varieties of functional paralysis which I have in this little work sought to differentiate, together with a synopsis of their leading clinical characters, on the supposition that in each case we have to do with a typical form of the disease.

#### CASES OF FUNCTIONAL PARALYSIS OF CEREBRAL ORIGIN.

##### *Varieties.*

1. Affection of Kinæsthetic Centres in Rolandic and marginal areas alone.

2. Ditto, *plus* an affection of sensory region of Internal Capsule.

3. Affection of sensory region of Internal Capsule alone.

4. Affection of efferent fibres from Kinæsthetic Centres in Rolandic area.

##### *Characteristics.*

Loss of muscular sense, with motor paralysis. Also slight loss of tactile sense, with defective power of localising.

Ditto, *plus* more or less complete hemianæsthesia.

[The paralysis flaccid or spastic.]

No motor paralysis. More or less complete hemianæsthesia (superficial, or superficial and deep, the latter including loss of muscular sense).

Aphemia or "hysterical mutism." If purely motor paralysis of limbs, then no loss of muscular sense.

#### CASES OF FUNCTIONAL PARALYSIS OF SPINAL ORIGIN.

5. Affection of Pyramidal System of Fibres in spinal cord.

Spastic paralysis, with no distinct loss of muscular sense. Also no "cerebral hemianæsthesia" or other cerebral symptoms.

6. Affection of Anterior Cornua in certain segments of spinal cord.

Flaccid motor paralysis with or without some loss of sensation. No distinct hemianæsthesia, and no marked loss of muscular sense.

<sup>1</sup> Fits are said by Briquet to be absent in only about one-third of the cases of hysteria. But in the sixteen cases of functional paralysis which I have recorded in this work, it will be found that there was not one in which hysterical fits had occurred, though in one there had been epileptic fits.



Having thus indicated in what relation the class of hysterical paralyses stand to the still wider group of functional paralyses, and where approximately the dividing line should fall, it only remains for me to reiterate my opinion as to the great difficulty that often exists in coming to a positive conclusion—a mere “preliminary diagnosis,” as I have termed it<sup>1</sup>—that we have to do with a case of functional paralysis rather than with one due to organic disease. Now, too, it seems that the problem is still further complicated, by the fact that marked symptoms of functional paralysis may co-exist in the same patient with other paralytic symptoms due to actual organic disease, such as we have found in Cases 11, 13, and possibly 14.<sup>2</sup>

If we once get rid of the old notion of hysteria as a kind of mysterious entity capable of conjuring up symptoms of its own, we may see less reason for the surprise that may at first be felt at the absence of absolutely distinctive symptoms in hysterical or any other form of functional paralysis. It simply comes to this, that the symptomatology of different forms of paralysis is governed in the main by the part of the nervous system which is at fault. What wonder then that functional disease should simulate disease of organic origin. This is why we have heard of “hysteria as a simulator of other diseases,” of its powers of “neuromimesis” and other metaphysical expressions : at the same time it explains perfectly the reason why there should be such an absence of differential phenomena between a functional paralysis and an organic paralysis of the same type. Hitherto, it is true, few seem to have thought that different types of functional paralysis were to be looked for—they have all been merged into one crude or chameleonic form, whose variations were supposed to be sufficiently accounted for by calling them “hysterical.” Looking at the matter, however, from another and, as I venture to think, a more rational point of view, we may see that the phenomena of mere functional disease should

<sup>1</sup> *Ante*, p. 1.

<sup>2</sup> It has, of course, long been known that organic disease of the nervous system often co-exists with hysterical symptoms ; but I have only lately realised the extent to which actual functional paralysis and paralysis of organic origin may co-exist so as greatly to lessen the apparent gravity of the cases, or *vice versa*.



not be expected to differ in kind but merely in degree from the forms of structural disease to which they are akin.

This difference in degree which we have a right to expect between the effect produced by an actual destructive lesion of a certain part of the brain, or of the spinal cord, and a mere lowering of functional activity of the same part, leads usually to certain gradational differences in the symptomatology of the two classes of cases. Yet further observation shows that there are no absolute criteria by means of which the two classes of cases are to be discriminated. It was formerly thought, and is still commonly taught, that the occurrence of well-marked muscular atrophy, of bed sores, of incontinence of urine and of fæces, or of nystagmus, were sure evidences of the organic nature of the affection in the course of which they occurred. As a general rule this is fairly true, but exceptions occur so frequently as to make it unsafe to rely too much upon the presence of either of these phenomena as infallible guides, whenever we have to deal with doubtful cases. The occurrence of even marked muscular atrophy in some functional cases is now a well-established fact.<sup>1</sup> Occasionally, too, bed sores are to be met with in such cases (CASE 12); whilst in other cases here recorded we have twice seen incontinence of urine or of fæces occurring (CASES 14 and 22), and have also met with a more or less well-marked nystagmus (CASES 9, 13, and 14). The existence of these exceptions makes it therefore, as I have said, unsafe to rely too strongly, in doubtful cases where one or other of these signs is present, upon the evidence which they afford in favour of the patient's symptoms being due to an organic lesion of some kind.<sup>2</sup>

We are thus still thrown back upon two sets of considerations to enable us to form a final judgment in doubtful cases. These considerations, upon which we are ultimately compelled to rely, are as follows :—

1. As functional defects tend specially to affect particular regions of the brain and spinal cord, we have to consider whether the grouping of symptoms met with in the case before

<sup>1</sup> *Ante*, p. 117.

<sup>2</sup> Still less reliance is to be placed upon the existence or not of "les trois hyperesthésies," to which Briquet (*loc. cit.*, p. 556) attaches so much importance; or to the absence or presence of the pharyngeal reflex or the plantar reflex upon which others dwell as guiding indications.



us is such as our clinical knowledge has taught us may be due to a defect in one or other of such regions.

2. We have to consider whether the mode of onset, coupled with the patient's general state, together with his or her immediate and remote history and family history, taken as a whole, most strongly favours the notion that we have to do with a malady due to mere functional defect, or to the existence of some organic lesion.

This may seem a complicated procedure, and not too calculated to land us in certainties ; but unfortunately it is the only safe method available for making a trustworthy diagnosis.

PROGNOSIS.—So far as the prognosis is concerned in this class of cases I have little that is new to add. It is, of course, always very much more hopeful in functional cases than it would be in anything like corresponding cases due to organic disease.

The ultimate establishment of a cure may be considered the rule in cases of functional paralysis, where they come under systematic and efficient treatment ; though the duration of the disease must be considered to be altogether uncertain.

In some cases, both of spasm and of palsy, a cure may be brought about comparatively speedily, and often abruptly. This, however, must not be looked for too often. In this respect my experience accords with that of Weir-Mitchell, who says :<sup>1</sup> "The chronic spasms of women with hysteria are, perhaps, among the most obstinately unmanageable of all the graver symptoms of this disorder. They are said at times, by the books, to make sudden recoveries. My own experience as to this is the same as in hysterio-palsies. I do not see abrupt recoveries—why, I cannot say—perhaps because the cases which reach me are always old ones, much treated." In many cases, indeed, as we have seen, the illness may be much more protracted, extending to one, two, or more years. Charcot with his large experience bears ample testimony to this. He says :<sup>2</sup> "Even among women there occur cases of hysteria where the phenomena are unchanging, permanent, extremely

<sup>1</sup> "Diseases of the Nervous System, especially in Women," 1885, p. 123 ; see also p. 35.

<sup>2</sup> *Loc. cit.*, p. 223 ; see also pp. 225-26 for some remarkable illustrations.



difficult to modify, and which sometimes defy all medical interference. And cases of this kind are numerous, very numerous. . . . the permanence and obstinacy of hysterical symptoms often prevent their being recognised for what they are."

Whilst, therefore, in cases where the duration has not been too much prolonged, and perhaps more especially in cerebral cases, when of hemiplegic type, there may be an abrupt recovery during some convulsive seizure, under the influence of some powerful emotion, or as a result of faradisation;<sup>1</sup> in other cases both of cerebral and of spinal type no such result is to be looked for. We must rather expect in the majority of cases that a prolonged period of the most careful treatment, both general and local, will be needed, extending in all probability over many months, before anything like a cure can be brought about. And then, too, there is the possibility of relapses, or of the affection of some other limb, especially where the patient is subject to convulsive attacks, and where the original paralysis has shown itself as an immediate sequence of an attack of hysterical convulsions.

There is, however, another category of cases in which the prognosis is distinctly worse. Some of the forms of paralysis of the spastic type have been known to persist without change for many years, and after such a period recovery may be impossible if (as there is evidence to show does sometimes happen) a definite sclerosis has become established in one or both columns of the spinal cord.<sup>2</sup> And the chances of complete recovery may, perhaps, be almost as hopeless in cases where a spinal paralysis of flaccid type has been too long neglected or inadequately treated, so that actual degenerative changes may at last have been set up in the anterior cornua of the cord of so distinct a nature as to preclude the hope of recovery. This last outlook is based upon rational conjecture rather than upon ascertained fact; still, the slow and tedious nature of the recovery in my CASE 22, in which a paralysis of this kind had merely lasted one year previous to the patient coming under treatment, seems to show plainly enough how bad the outlook might be if the patient only came under efficient treatment at a much later date.

<sup>1</sup> Briquet, *loc. cit.*, p. 713.

<sup>2</sup> It seems to me just possible that my CASE 13 may be one of this kind.



It is believed by Briquet, and also by Weir-Mitchell, that the paraplegic form, though not so common, is much more obstinate and intractable to all methods of treatment than the hemiplegic form of hysterical paralysis.

Briquet says :<sup>1</sup>—"Il faut ordinairement plusieurs mois de soins journaliers pour arriver à une amélioration quelque peu notable. Dans un certain nombre de cas qu'on peut évaluer au tiers des paraplégies, ce traitement prolongé pendant cinq et six mois ne produit aucune amélioration notable dans la motilité des membres inférieurs."

**TREATMENT.**—Indications as to the nature of the treatment to be adopted in these cases of functional paralysis, whether they be of cerebral or of spinal origin, may be gathered from the record of the cases themselves. The principal points to which attention should be directed may, however, be here recapitulated.

If, as is often the case, patients are anæmic and more or less debilitated, efforts must be made by means of suitable compounds of iron, arsenic, strychnia and other tonics, together with cod-liver oil and maltine and a nourishing diet, to improve the general health. Or it may be that an inveterate habit of vomiting has to be broken through before any special treatment directed to the cure of the paralysis can be initiated. Menstrual complications, insomnia, or obstinate constipation will also often require our special attention.

In regard to local treatment, the utility in slighter cases of strong faradic currents to the muscles of the affected limbs, and also of the frequent application of the wire-brush to the skin, is well known ; each of them is sometimes capable of effecting a rapid cure. But where the cases are more severe, and therefore more obstinate in their response to treatment, similar measures must be persevered with, and often over long periods, before any distinct signs of improvement are to be expected. If the patients can sit up, another most potent means of cure is to treat them with statical electricity, drawing sparks from different portions of the affected limbs. This mode of treatment is especially to be recommended in cases of functional paralysis of cerebral origin, as, apart from its

<sup>1</sup> *Loc. cit.*, p. 717.



physical influence, the mental effects produced by such treatment are often highly beneficial. On the other hand, in some spinal cases, good seems to result occasionally from the use of the constant current—by allowing, that is, a constant current from fifteen to twenty cells to flow through the cord daily for about a quarter of an hour. Combined with this electrical treatment of various kinds, we should also have resort to daily massage and shampooing, together with passive movements of the affected limbs. Good may also be obtained by the use of sulphur, of brine, or of tepid needle baths on alternate days. Application of the actual canterbury over the spine may also occasionally be indicated. Functional spasms or contractures often prove extremely refractory to all methods of treatment, and their duration may be prolonged for years. At other times they may be more amenable to the assiduous daily employment of massage, or that failing, we may have recourse to daily subcutaneous injections of morphia or of atropia, in suitable doses, in the immediate neighbourhood of one of the fixed joints. This latter method seemed to be most efficacious in CASE 17.

Throughout the whole course of treatment the patients must be dealt with firmly but encouragingly; they must be constantly exhorted to new efforts, and bidden to expect a complete recovery if they will only do their best in the way of helping to achieve it. This moral treatment is needful in both forms, though it is perhaps more helpful, as it seems to be more definitely indicated, in the cases of cerebral than in those of spinal origin. It is again in the cerebral, or real hysterical cases more especially, that the removal of the patient from her previous surroundings, and particularly from the influence of a number of over-sympathetic friends, becomes most advisable, with a view to ensure the success of our efforts to cure. Other means of dealing with these cases are by hypnotism and the so-called Weir-Mitchell system of treatment.

In regard to hypnotism it may be said that it is a method of treatment for such cases which has been very little tried in this country, and that the results of treatment of this kind in France have not been particularly encouraging. It not unfrequently happens, indeed, that such patients prove to be not hypnotisable. This was found to be the case, for instance, in



each of the three patients of Charcot suffering from traumatic brachial monoplegia to which I have had occasion to refer.<sup>1</sup>

In regard to the Weir-Mitchell treatment, consisting in separation from all old friends and previous surroundings, coupled with abundant feeding and methodical exercise by means of massage and faradism, it must be said that unquestionably the results have in many cases been excellent, and such as could scarcely have been obtained by any other method, where the disease has been of a very long duration, and where the patient's general treatment and surroundings have been, through mistaken kindness and an excess of sympathy, either injudicious or actually of the worst description. Unfortunately, however, this method of treatment is too costly to be available for large numbers of private patients ; and it is almost impossible of adoption in ordinary hospitals because of the excess of nursing that is required, and because it is found impossible for the resident medical officers (even if they possessed the necessary attributes and experience) to devote so much time and energy to the treatment of individual cases as becomes necessary when the patient is submitted to this comparative isolation and utter change in previous modes of living.

Nor must it be thought, even when such treatment is carried out under the most favourable conditions, that a cure is always to be counted upon in the course of five or six weeks. In some cases it may be so, but in others it is far otherwise. Thus, speaking of one such case<sup>2</sup> that had been under his care, Weir-Mitchell says :—"Enough to say of this case that it went on slowly gaining ground, and was under my care a year before the patient could walk well enough on crutches to go home with a cheerful future. It was not a brilliant case, and it taxed nurse and doctor to the uttermost—a case urged and scolded, and teased and bribed, and decoyed along the road to health ; but this is what it means to treat hysteria. There is no short cut ; no royal road." And again, speaking of the very next case that he records, he says : "A whole year was needed to make her well able to take up afresh her full round of social and household duties. In fact, even with the best of self-help from the patient, the cure of any one of these cases is a long and arduous course of education."

<sup>1</sup> *Ante*, p. 43.

<sup>2</sup> *Loc. cit.*, pp. 31-36.



In conclusion, I would call attention to the fact that the good results that are generally admitted to follow from the use of faradism, from statical electricity and the drawing of sparks, from frequent massage, and from passive movements, in these cases of functional paralysis of cerebral origin, are thoroughly harmonious with my view that the centres at fault in such cases are sensory centres of kinæsthetic type rather than "motor centres." All the efficacious modes of treatment above indicated would, in fact, tend to send awakening stimuli directly to centres of this type, and so might, as we can easily conceive, be capable of slowly modifying their lowered nutritive condition. In the cases of spinal origin it must be supposed that such procedures are efficacious because of the close relationship, both structural and physiological, that exists between sensory and motor centres in the same segment of the spinal cord ; there is, however, room for doubt whether all these methods are so directly and speedily serviceable in them as they are in the cases where the paralysis is of cerebral origin.







## APPENDIX A

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### THE "MUSCULAR SENSE": ITS NATURE AND CORTICAL LOCALISATION.<sup>1</sup>

HAVING been honoured by a request from the Council of the Neurological Society to open a debate upon "The Muscular Sense: its Nature and Cortical Localisation," I willingly undertook this duty, not because I thought the task an easy one, but, recognising to the full all the inherent difficulties of the subject and the unsettled state of opinion thereon, I fully concurred in the notion that such a discussion might do much good. If it does not lead to the immediate settlement of the many points still in dispute, it may, at least, serve to bring out into clearer light the nature of the problems to be settled by future workers and thinkers, in order that unanimity may ultimately prevail. I say "thinkers" advisedly, because this is eminently one of those subjects on which observation and experiment alone will not suffice, especially observations and experiments conducted upon lower animals.

#### INTRODUCTION.

It may be regarded as a physiological axiom that all purposive movements of animals are guided by sensations or by afferent impressions of some kind.

Physiologists know that the several kinds of movements which animals are accustomed to perform are only artificially and for purposes of convenience divided into such classes as (1) automatic or reflex, (2) secondary-automatic, (3) instinctive, (4) ideo-motor, or (5) volitional.

From the point of view of the dependence of these several kinds of movement upon sensation, or upon afferent impressions either

<sup>1</sup> Portions of a paper read before the Neurological Society of London, on December 16, 1886, which, together with the Discussion thereon, appeared in *Brain* for April, 1887.



actual or revived, no fundamental distinction can be drawn between them.

In reply to this it might be alleged that volitional movements constitute a class apart, seeing that their performance implies as a necessary factor, which the others do not, the presence of, and illumination derived from, Consciousness. But it must be borne in mind, (*a*) that Consciousness is not itself a factor, it is rather of the nature of an epiphenomenon: (*b*) that it exists in varying degrees during the executions of different kinds of voluntary movements, being of maximum intensity during the performance of unfamiliar muscular actions and of minimum intensity (almost vanishing) in association with easy and familiar voluntary acts; and (*c*) that as a matter of fact, it is often almost impossible to draw anything like a dividing line between ideo-motor and voluntary movements, so insensible are the gradations between them.

If we compare for a moment a simple reflex movement with a volitional movement, some important differences may nevertheless be found, which are of great significance from the point of view of the subject with which we are now concerned.

A reflex movement may be evoked and guided to its completion by afferent impressions which are wholly unfelt; we have here apparently nothing else than a direct relation established between the paths of afferent impressions and the nervous cell and fibre tracts needful for evoking the suitable activity of some definite sets of muscles. In other words, the line of least resistance for the molecular movements set up in the cells on the afferent side is found to lie along the internuncial fibres connecting these with certain groups of motor cells, and thence outwards through their efferent nerve fibres to the muscles. Even in ideo-motor movements something of the same kind seems to occur; that is to say, there seems to be an equally well-formed or beaten tract (by means of nerve fibres) between the cells of the perceptive centres in which the revived sensory process or idea occurs, and the particular motor mechanisms connected therewith—whose excitation gives rise to the fitting movement.

But simple, familiar, voluntary movements are attended by so little conscious illumination as to be often indistinguishable in every way from ideo-motor movements. The utterance of words in ordinary speech, that is, in the person's own language, is effected by movements which may be described either as voluntary or as ideo-motor. The whole act of speech is truly a voluntary performance; but the enunciation of each word takes place with all the ease and lack of attention typical of an ideo-motor movement.



It is, however, in the performance of a new or unfamiliar voluntary action that we find the widest divergence from the phenomena attendant upon the execution of a simple reflex movement. Here we have the full blaze of consciousness, the whole attention of the performer, directed to the production of the movement in the desired manner, though this result may not be attained till more or less marked failure has occurred on many occasions. What can guide these endeavours to perform new movements save sensory impressions, actual or revived? What is the result of this concentration of attention upon present and revived sensory processes? This latter question cannot be answered definitely and in detail; but seeing that one result of practice is to make the new movement after a time quite easy of execution, and that further practice still causes it to recur with such facility that it may be fully entitled to take rank as an "ideo-motor" or even as a "secondary automatic" movement, we are fairly entitled to conclude that one of the hidden effects, whose existence we can only infer, has been the laying down of beaten paths for efferent stimuli, from the sensory centres which have been concerned in guidance to the particular combinations of motor nerve mechanisms whose excitation is needful for evoking the movements in question. This being so, the "stimuli" in question must be considered to be in part, at least, the molecular movements occasioned by the revived activity of the sensorial centres.

But if it be assumed that this is what occurs when, by dint of long practice, an at first difficultly-executed voluntary movement becomes, in process of time, a movement so easy of execution as to recur independently of conscious attention and with machine-like regularity, three important consequences follow:—

In the first place, it seems to afford clear proof that, even as in ideo-motor actions so in voluntary movements, the immediately evoking stimuli flow out from the sensory centres concerned with the production of such movements—the voluntary movement grows into the ideo-motor movement, and then unmistakably the guidance is wholly through the sensory centres, for then (as we have seen in the case of a simple reflex movement) the line of least resistance for molecular movements from the sensory cells is through certain new communicating fibres bringing them into relation with definite groups of motor nerve mechanisms.

Secondly, it seems clear that the same motor mechanisms must be concerned with the production of the new voluntary movements as with the ideo-motor or secondary automatic movements into which they become converted at a later date. We have to do it.



these two sets of cases with differences in the degree of perfection of the nervous mechanisms, and with different degrees of perfection in the functional and structural relations between the sensory and the motor mechanisms especially, rather than with an alteration in the position in which the movements are, so to speak, organised. It is, therefore, in my opinion, a fundamental error to look for special voluntary motor centres. The strictly motor side of voluntary motor mechanisms should be identical with, or lie side by side with, the strictly motor side of "ideo-motor" or "secondary-automatic" mechanisms of the same type.

Thirdly, we may safely conclude that when once the ways or beaten tracts have been laid down by which certain sensory departments are connected with certain motor mechanisms for the performance of voluntary movements, the former may be incited to renewed (or ideal) activity, and may be followed by appropriate responsive movements, almost, if not quite, independently of, and certainly without any need for, Consciousness as an attendant of such revived sensorial activity—in other words, when once the internuncial tracts have been clearly established from cortical sensory centres to bulbar or spinal motor mechanisms, it is not in the least necessary that Consciousness should be an appanage of this revival, since even the unfelt recall by associational processes of activity in the guiding sensory centres may, by causing an outflow of molecular movements, now suffice with machine-like regularity to evoke the accustomed motor reactions, as in the case of a skilled dancer or a skilled player upon a musical instrument.

#### SENSATIONS RESULTING FROM MOVEMENT: KINÆSTHETIC IMPRESSIONS.

Before entering into any details concerning the sensory guidance of movements in general, something requires to be said about one particular class of sensory impressions which are of great importance in this relation. I refer to the body of sensations which result from or are directly occasioned by movements. This constitutes a complex of impressions which for the sake of convenience of reference, as well as for the purpose of indicating their common functional relations, I have proposed<sup>1</sup> to include under the designation *Kinæsthesia*, or the "sense of movement." Perhaps I ought rather to have spoken of "sensations of movement," as Wundt does,<sup>2</sup> but the former term is more in accordance with those already in

<sup>1</sup> *The Brain as an Organ of Mind*, 1880, p. 543.

<sup>2</sup> Wundt says:—"Les sensations du mouvement, comme nous avons montré



use in connection with this subject (e.g., "muscular sense," and "sense of force"). Impressions of various kinds combine for the perfection of this "sense of movement," and in part its cerebral seat or area corresponds with the sense of touch. Thus, under it are included, as its several components, cutaneous impressions, impressions from muscles and other deep textures of the limbs (such as fasciæ, tendons, and articular surfaces), all of which yield conscious impressions of various degrees of definiteness; whilst, in addition, there seems to be a highly important set of unfelt or but little felt impressions which guide the volitional activity of the brain, in ways hereafter to be defined, and which serve to bring it into relation with the different degrees of contraction of all muscles that may be called into action.<sup>1</sup>

By means of this complex of sensory impressions we are made acquainted with the position and movements of our limbs, we are enabled to discriminate between different degrees of "resistance" and "weight," and by means of it the brain also derives much unconscious guidance in the performance of movements generally.<sup>2</sup>

Of course it may be easily said, and doubtless will be said, by those who have not yet realised the importance of bestowing special attention upon this complex of impressions, that it is unsuitable to describe, as though it were a distinct endowment, the means by which we receive and appreciate a group of impressions having such diverse sources of origin. This mere technical or formal objection seems to me, however, to have little weight, when we consider that from a functional point of view they constitute a group of impressions altogether apart, recurring with extreme frequency, and always in more or less similar combinations, during almost every hour of our waking life—subserving also, as we hope hereafter to show, a most important purpose. I think, therefore, we are warranted in speaking of the reception of this group of sensations under the name of kinæsthesia, or the sense of movement. There

précédemment, sont pour nous *des produits fusionnés complexes*, provenant de sensations d'origine différente" (*Élém. de Psych. physiol.* Trad. Franç., 1886, i., p. 421).

<sup>1</sup> I have introduced a qualifying phrase after the word "unfelt" above, because on reflection I think I have been wrong hitherto in saying that "muscular sense" impressions are wholly unfelt. There must be a kind of consciousness associated with them if, as seems now to be established, our knowledge of the position of our limbs, as well as of differences in weight, is in the main due to "muscular sense" impressions.

<sup>2</sup> These impressions are almost always closely linked with others of a tactile, visual, or auditory order, so that their associated ideal recall presents no sort of difficulty.



will certainly be a real convenience in being able to allude to such impressions briefly, as "kinæsthetic impressions." It is confessedly a mixed group partly "intrinsic" and partly "extrinsic" in their origin.

From one point of view, especially, important differences separate this synchronous and fused group of impressions from all other sensory impressions—differences to which it will be as well at once to allude.

Ordinary extrinsic sensorial impressions commonly play the part of instigators to movement. Thus impressions of smell, sight, hearing, touch, and taste are either the immediate or the remote instigators of the great majority of the movements executed by animals.

The movements so stimulated are in almost all cases of a more or less purposive type, directed, that is, to the attainment of some end.

During the whole time that such movements are being evoked the animal is constantly receiving those groups of mixed afferent impressions which we have styled "kinæsthetic," called into existence by the mere movements themselves.

Kinæsthetic impressions are never instigators of movement in the same sense that olfactory impressions may be instigators of movement. Visual impressions and auditory impressions are not only frequent instigators of movement, they are also respectively all-important guides for certain classes of movements. From a functional point of view, kinæsthetic impressions are guides only; these functional uses are, however, co-extensive with movements themselves, since, in conjunction either with visual or with auditory impressions, they act as guides for all sorts of movements. As it is with visual and auditory, so is it with kinæsthetic impressions, their guiding influence in the production of movements is brought to bear partly under the form of actual sensations and partly under the form of revived impressions (the memories of past activity).

Seeing that kinæsthetic impressions must be as numerous and as endlessly diversified in their kinds and combinations as movements themselves, it follows that large tracts of the brain ought to be concerned with their registration for future use in the guidance of all kinds of voluntary movements.<sup>1</sup>

<sup>1</sup> I purposely leave out of account, for the present, the fact that kinæsthetic impressions enter largely into the composition of nearly all our visual and tactile impressions; movements of the eyes, or movements of the hands and fingers, not only vastly increasing the range of possible visual or tactile impressions, but also entering, as it were, into their very structure, and thereby enabling us to recognise and judge what philosophers call the primary qualities



Except during the last forty years, the occasional references which have from time to time been made to kinæsthetic impressions have appeared rather in the writings of philosophers, than in those either of physiologists or pathologists. Yet the first mention of such impressions goes back, according to Sir William Hamilton, to a rather remote past. He tells us that two Italian physicians, Julius Cæsar Scaliger, in 1557, and Cæsalpinus of Arezzo in 1569, quite independently of one another, were the first to recognise and definitely state that the exercise of our power of movement is the means whereby we are enabled to estimate degrees of "resistance," and that by a faculty of "active apprehension" which was by them contrasted with touch as "a capacity of sensation or mere consciousness of passion." These early references to such an endowment, like those of Maine de Biran and Sir William Hamilton himself, have, for the most part, supposed the existence of a separate faculty or endowment associated with volition, or the mere will to move, to which such names as the "sense of effort," the "sense of force" or the "locomotive faculty" have been given—agreeing very closely with what Wundt has since termed the "sense of innervation."

Some of the reasons why physiologists should for so long have paid but scant attention to this class of impressions may be thus enumerated:—

(1) The most typical and important group of kinæsthetic impressions,—viz., those derived from the muscles themselves, belong, like visceral impressions, to the class of "intrinsic" sensations, which, as a whole, receive but little of our conscious attention under all ordinary conditions of life. These are "means" rather than "ends," and consequently soon become sub-conscious modes of activity.

(2) These impressions are not directly concerned with the organism's life of relation—that is, they do not directly stimulate its converse with the outside world. Impressions derived from movement cannot in themselves be, nor are they when ideally revived, first-hand instigators of movement, however much they may aid in the repetition of movements previously effected.

(3) Owing to the nature of this sensory endowment, it is one which cannot be investigated by experiments upon animals. The presence or absence of ordinary sensory endowments may be tested

of matter—viz., solidity, extension, figure, etc. I also omit further mention of the fact, that kinæsthetic impressions (unassociated with consciousness) likewise act as guides in the great class of reflex movements which are produced independently of the cerebral hemispheres, by the mesencephalon and cerebellum, as well as by other sensori-motor couples of lower grade.



in the lower animals, by looking for the recurrence or not of some particular motor reactions which we know are apt to be excited by the presentation of this or that stimulus to the sense which is being tested. The sense of movement being however a so-called "intrinsic" sense, and not an instigator of movements, cannot be tested in this manner. Indeed it may be safely said that no experiments that can be made upon the lower animals, even upon monkeys, are capable of throwing any decisive and direct light upon the presence or absence of the most important element in this endowment,—viz., the impressions emanating from contracting muscles.<sup>1</sup>

### *The Muscular Sense.*

It should be stated here that the announcement of the existence of a "special class" of sensations emanating from muscles, came from Sir Charles Bell. He first postulated the existence of a special endowment, to which he applied the name "*muscular sense*," whilst the reality of the sensations emanating from muscles was first demonstrated and accurately estimated by the experiments of E. H. Weber,<sup>2</sup> who, however, spoke of the endowment by which we are enabled to discriminate different degrees of "resistance" or weight, as the "sense of force." E. H. Weber was the first to make definite investigations as to the differences in weight which could be appreciated by the mere tactile sense of contact and pressure whilst the hand was at rest on a flat surface, and, subsequently, to ascertain by careful experiments that a considerably heightened power of discrimination existed when the muscles were called into play—that is, by no longer allowing the hand to rest upon a flat surface, but by slowly moving the arm when different weights were successively placed upon the palm. Numerous comparative experiments of this kind made by Weber, and since confirmed by other investigators, have shown that the activity of the muscles adds greatly to our ability to discriminate differences in "weight" or "resistance."

<sup>1</sup> Thus it happens, perhaps, that the evidence on which Ferrier relies in support of the notion that the "muscular sense" was defective in three monkeys operated upon by him (See *Functions of the Brain*, 2nd ed., 1886, pp. 335, 340, 344), is no more convincing to me, than is the evidence of Hitzig and Nothnagel to him, in support of their cortical localisation of muscular sense centres (p. 379). We must have observations on men and women for the solution of this problem, who can tell us what they know of the position of their limbs, and of their movements (active or passive), as well as concerning their ability to appreciate differences in weight.

<sup>2</sup> *Annotationes anatom.* (Progr. collecta.) Proleg. xii. (1831). *Tast- und Gemeingefühl.*



Thus, by the mere sense of cutaneous pressure it has been found that the addition of one-third of the original weight, whatever it may have been, is needful to produce a perceptibly different impression; while, on the other hand, when muscles are allowed to be called into play the power of discrimination is so greatly heightened that an addition of no more than  $\frac{1}{17}$ th of the original weight is generally capable of yielding a distinguishable difference in the resulting impressions.

This constitutes, in fact, the physiological proof of the existence in us of a distinct ability to discriminate different degrees of weight or resistance by impressions resulting from various states of tension or contraction in our muscles. This ability is lost in certain diseases, and its absence gives rise to disordered movements when the eyes are closed, as well as to ignorance of the position of the limbs and other related defects.

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Having said thus much concerning kinæsthetic impressions as a whole, and "muscular sense" impressions in particular, it may now be well to endeavour to show that both kinæsthetic impressions as a whole and these "muscular sense" impressions in particular, are, like other sensations, capable of being revived in idea. It seems desirable to advance something like a formal proof of this here, as, in our opinion, these ideal revivals of kinæsthetic impressions aid in the performance of most important functions—that is, in the execution of all the voluntary movements we perform.

Just as the blind man can recall to mind previous sight impressions, or the deaf man sounds previously heard, so can the man who has had an arm amputated call to mind movements which this limb had formerly executed, by reviving in idea the kinæsthetic impressions previously associated therewith. Many remarkable instances of this have been recorded by Weir-Mitchell in his work entitled *Injuries of Nerves and their Consequences* (p. 348, *et seq.*). I am inclined to think that in very many of these cases the conjuring up of subjective impressions of the several kinds mentioned is more facile than in persons who are neither blind, deaf, nor armless; and that, in many instances, the impressions so revived assume such an intensity as to appear more like hallucinations than ordinary sensory revivals. Weir-Mitchell says:—"Nearly every man who loses a limb carries about with him a constant or inconstant phantom of the missing member, a sensory ghost of that much of himself. . . . The sensation of the presence of the part removed exists in many persons as soon as they come from under the influence of the



anæsthetic used at the time of the amputation, but in others it only arises after they cease to suffer pain, being rarely delayed beyond three weeks. The more healthy the stump, the less perfect, after a time, becomes the sense of the existence of the limb removed, while it is liable to be recalled by a blow or anything which causes a return of subjective sensations. . . . Even in those who are least conscious of the missing part, I have amazed them by suddenly recalling it with the aid of a faradic current applied to the nerves of the stump. It is not easy to forget the astonishment with which some of these persons re-awaken to a perception of the long-lost leg or arm."

In regard to the ideal recall of movements of the missing member Weir-Mitchell says :—" We find that in a very small number there is no consciousness of power to stir any part of the absent members by force of will. All others are able to will a movement and apparently to themselves to execute it more or less effectively, although in most of the amputated such phantom motions are confined to the fingers or toes, which rarely seem to possess the normal range either of flexion or extension. Yet the certainty with which these patients describe the limitations of motion, and their confidence as to the place assumed by the parts moved, are truly remarkable; while these restricted movements are pretty surely painful, and the effort is apt to excite twitching in the stump. . . . A small number have entire and painless freedom of motion as regards all parts of the hand. 'My hand is now open, or, it is shut,' they say. 'I touch the thumb with the little finger.' 'The hand is now in the writing position,' etc. Between these cases and such as are conscious of an immobile member, every grade of difference as to motion is to be found."

Another very remarkable fact of some importance is that, according to Weir-Mitchell, such sensations may be roused at will and even revived after they have been in abeyance for years, by stimulation of afferent nerves. He says :—" If we faradise the track of the nerve in or above the stump, we may cause the lost fingers and thumb to seem to be flexed and extended, and, what is most remarkable, parts of which the man is conscious, but which he has not tried to stir for years, may thus be made to appear to move, to his utter amazement. In one case I thus acted on the nerves, so as to cause a thumb which for years was constantly and violently bent in on the palm to straighten out completely. On breaking the circuit without warning, the patient exclaimed that his thumb was cutting the palm again, and the same result was obtained by shifting the conductors so as to put the nerves out of the circuit. . . . In a case of amputation at the shoulder-joint, in which all consciousness of the limb had



long since vanished, I suddenly faradised the brachial plexus, when the patient said at once, 'My hand is there again. It is bent all up and hurts me.' These impressions are correctly referred by the patient, so that faradisation of the musculo-spiral, or the ulnar, gives sensations of movement in the related parts."

These effects of faradisation of the nerve trunks are very interesting, and are entirely in accordance with the statements previously quoted to the effect that the more healthy the stump the less perfect, after a time, becomes the sense of the existence of the limb that has been removed. If a mere blow upon the stump tends to recall such a sensation, how much more should a definite stimulus applied to the very nerves themselves. These facts simply mean that the kinæsthetic centres in relation with a lost limb are apt to drop into a condition of functional inertia, but that they are easily roused from this state by the advent of afferent stimuli, and that they are all the more powerfully roused when the stimulus applied is in itself powerful. In these statements, however, we are a little taking for granted the correctness of the view as to the afferent nature of these impressions, which has not yet been formally considered (see *Brain* April 1887, p. 42), although some of the strongest evidence in its favour has already been adduced in preceding pages.

In regard to the varying power of recall of kinæsthetic impressions exhibited by different persons whose limbs have been amputated, this may be due, in part, to varying conditions of the stump as above indicated; and perhaps more especially to varying states of the nerve ends, and the extent to which they are invaded by processes of sclerosis. Beyond all such causes of difference, however, we may expect that there would be naturally, in different individuals, great variations in the power of recalling kinæsthetic impressions, just as an extreme variability is met with in different persons in regard to their power of recalling visual or auditory impressions, as F. Galton has so fully shown in the case of the former. A few instances of such variations will well illustrate this part of our subject.

Galton made a series of careful inquiries to ascertain to what extent different persons are endowed with the power of recalling, or seeing with the mind's eye, distinct images of objects in their natural grouping and colouring, taking as a trial-subject the person's own breakfast table as he or she sat down to it in the morning. The one hundred answers which he received disclosed an extraordinary range of variation in this respect among different individuals, as may be seen by the perusal of his interesting essay on *Mental Imagery*.<sup>1</sup>

<sup>1</sup> *Inquiries into Human Faculty*, 1883, p. 83.



One of those who had the highest power of recall answers:—“Thinking of the breakfast table this morning, all the objects in my mental picture are as bright as the actual scene.” One of the worst answers:—“No individual objects, only a general idea of a very uncertain kind.” While the person who possessed the lowest power of all in this direction, answered:—“My powers are zero. To my consciousness there is almost no association of memory with objective visual impressions. I recollect the breakfast table but do not see it.” Other very interesting examples of variation in this power of recalling visual images are cited. Thus Mr. Galton says:—“One statesman has assured me that a certain hesitation in utterance which he has at times is due to his being plagued by the image of his manuscript speech, with its original erasures and corrections. He cannot lay the ghost, and he puzzles in trying to decipher it. . . . A distinguished writer on metaphysical topics assures me that he is exceptionally quick at recognising a face that he has seen before, but he cannot call up a mental image of any face with clearness. . . . There are a few persons in whom the visualising faculty is so low that they can mentally see neither numerals nor anything else; and again there are a few in whom it is so high as to give rise to hallucinations.”

With variations such as these to be met with in regard to the impressions of a vivid sense like that of sight, it is much more easy to explain, by the principle of individual variation, some of the remarkable differences in the power of recalling kinæsthetic impressions met with among the persons examined by Weir-Mitchell.

The cases to which we have just been referring are instances in which kinæsthetic impressions as a whole are revived. There is, however, good evidence to show that “muscular sense” impressions in particular are also capable of being revived in idea. It has been already shown that these are the impressions which almost, if not quite alone, are concerned with the estimation of weight or resistance. If such impressions, however, had not been capable of being revived in idea we should have no power of discriminating differences in weights when they are lifted in succession, and still less should we have that power which we possess of lifting certain bodies and saying at once what is their approximate weight.

In the former case we have mentally to compare our present feelings of resistance with our memory of similar impressions experienced a few moments before; whereas, the fact of our possessing such powers as are referred to in the second case shows that we are capable of acquiring ingrained “standards of weight” by the constant exercise of this faculty, dependent of course upon our



power of ideally recalling such impressions, so that at last we are enabled to judge intuitively as to the approximation of bodies to certain ideal standards of weight, just as we are enabled to judge of the approximation of certain presently perceived colours or sounds to certain "standard" visual or auditory impressions. In regard to this point Professor Bain says: <sup>1</sup>—"Absolute weight implies a permanent standard, and a permanent impression of that standard. When I lift a weight, and pronounce it to be seven pounds, I make a comparison between the present feeling and the impression acquired by handling the standard weight of seven pounds or things equivalent thereto. This absolute comparison, therefore, implies the enduring and recoverable sensibility to impressions of resistance, which is also a fact of the human constitution. . . . A receiver of posted letters contracts an ingrained sensibility to half an ounce, and can say, of any letter put into his hand, whether it produces a sensibility equal to or under the standard."

But it is one of the fundamental positions of physiological psychology which Professor Bain has strongly enforced, that a renewed feeling or idea must depend upon the action of precisely the same parts as the original feeling. On this head he says <sup>2</sup>:—"What is the manner of occupation of the brain with a resuscitated feeling of resistance, a smell, or a sound? There is only one answer that seems admissible. The renewed feeling occupies the very same parts, and in the same manner as the original feeling, and in no other parts, nor in any other assignable manner. . . . For where should a past feeling be re-embodied if not in the same organs as the feeling when present? It is only in this way that its identity can be preserved; a feeling differently embodied would be a different feeling."

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#### THE PART TAKEN BY "MUSCULAR SENSE" IMPRESSIONS IN THE EXECUTION OF VOLUNTARY AND AUTOMATIC MOVEMENTS.

##### (a) *Voluntary Movements.*

In voluntary acts we have not merely to account for the production of a movement, but of a movement of a certain kind, in which the action of each set of muscles brought into play is duly regulated so as to lead to the exact result desired. And, seeing that the volition or desire to bring about such and such movements originates in the cerebral cortex, we are bound to admit that the purely

<sup>1</sup> *The Senses and the Intellect*, 3rd ed., p. 93.

<sup>2</sup> *The Senses and the Intellect*, 3rd ed., p. 338.



volitional qualities of the movement must also depend upon cerebral influence. Hence the strength, the continuance, the rapidity, and the direction of movements are variable according to the precise nature of the cerebral incitation or volition. As Jaccoud says, "The strength of the movement is regulated by the strength of the initial motor impulse; the extent depends in reality upon the same influence; the rapidity results from the more or less rapid succession of voluntary impulses; and the direction is determined by the voluntary localisation of the incitation upon certain groups of muscles." It is also important to recollect that, in the execution of a complex movement, any alteration that we may desire to bring about in respect of any one of these volitional qualities is, by the mere change in the volition itself, immediately effected with reference to the movement as a complex whole. Jaccoud illustrates this as follows<sup>1</sup>:—"I am walking, and then I wish to walk more quickly. Hardly have I conceived the desire before the mode of walking is changed: it has become, in short, more rapid. This intervention of my will manifests itself, therefore, by a change in the movement of locomotion as a whole. This change is the final result of a series of partial modifications which have been brought about in the original movement; this is incontestable. But I have not needed a parallel series of volitional acts; a single volition has sufficed. I have willed to walk more quickly, and I have then walked more quickly, without knowing anything, without even requiring to know anything, of these intermediate modifications." In the same way, alterations in any one of the other volitional qualities of a complex movement are found to have direct bearings upon the movement as a whole. These seem to be the principal facts that should be mentioned with regard to the mere volitional act; and I am quite disposed to agree with Landry when he says, in opposition to the views of several physiologists, that the volition itself includes only an incitation to a specific kind of movement, and that we must execute this movement in order to become acquainted (inferentially) with the quantity of nervous action brought into play.

But besides these *qualities* of the movement which are determined by the volition, we have to consider the execution of the movement itself as a compound of several simple movements, brought about by the simultaneous and successive contractions of different muscles, which are perfectly harmonious and constant in their mode of action. This machine-like precision of action—the result of what is usually

<sup>1</sup> 'Les paraplégies et l'ataxie du mouvement,' 1864, p. 594.



known by the name of *co-ordination*—is now admitted by most physiologists to depend upon certain pre-established, though gradually acquired, nerve-connections between the different elements of the spinal cord and medulla oblongata. The movements are machine-like, inasmuch as they depend upon certain organic combinations in the spinal cord and medulla, and after these connections have once been fully formed the will has little more to do with them; the movements ordinarily take place in a definite manner, the will qualifying their mode of execution only. It requires a special exercise of mental power in order to execute certain complex movements in a way different from that which has become habitual. But in these cases, as well as when we are learning to execute a new complex movement, we give no attention whatever to the muscles by which the movement is effected—the states of these individually do not fall within the scope of our consciousness. Were it otherwise, the number and situations of the several muscles would reveal themselves to all, during the performance of different movements. In our tentative efforts we think only of the movements themselves—how to combine the more simple, so as to produce the more complex.

The kind of movement produced is, therefore, evidently dependent upon the *distribution*, in the medulla and spinal cord, of the volitional impulse; and, in a complicated motor act, its incidence upon particular groups of cells, which are the organic representatives of certain potentialities for simple movements, gives rise to the production of the complex movement. The more frequently such a complex movement has been executed, the more completely may we suppose these various groups of cells become bound together into one system by connecting fibres, and the more possible is it for the movement which they represent to occur in a thoroughly automatic manner, and often without much need for cerebral intervention. The mechanism of co-ordination is, therefore, purely spinal. This fact was fully recognised by Volkmann more than forty years ago, as appears from the following quotation:<sup>1</sup> "The physiological accomplishment of movements has nothing to do either with consciousness, or with unconsciousness, for the mind has not the least notion of the details of this operation; and even in voluntary movements it knows nothing concerning the nerves or the muscles by the intervention of which the process is accomplished. In fact, the mind does nothing in this case but give the incitation; and if this incitation has for an effect any co-ordinated movement, it is

<sup>1</sup> Art. *Nervenphysiologie*, in Wagner's *Handwörterbuch*, 1844.



altogether simply because the organ which receives the incitation is arranged in such a fashion that it necessarily produces a co-ordinated movement." Precisely the same views as these were also expressed, at about the same time, by Arnold and Müller.

Thus, the work of co-ordination tends to become entirely spinal and organic; the movement itself depends upon the spinal cord, though its particular *qualities* of force, rapidity, etc., are dependent upon the cerebral or volitional influence. The cerebrum may, therefore, also be said to exercise a kind of co-ordination—it co-ordinates or adapts the movements which are organically represented in the spinal cord, so as to make them accord qualitatively with the aim conceived. But, in order that the cerebrum may exercise this power, it seems perfectly obvious that it should be instructed from moment to moment as to the exact nature of the movement actually produced, so that it may know whether to continue in its present mode of action, or whether to vary the quality of the volition, in order better to attain the desired end. Now, according to Jaccoud, whose treatment of this subject is most excellent, the cerebrum obtains these necessary guiding impressions from different sources. He says: "These indispensable notions the brain obtains directly through the sense of sight; or, instead, it deduces them indirectly from the instructions which reach it as to the situation of the parts which move and the condition of the contractile organs which move them; these instructions are furnished by impressions through the muscular sense, and through the sense of touch." The sense of sight is what we chiefly rely upon in early years, and in acquiring new movements generally. We all know how long it is before a person learning to play upon a musical instrument can do without the aid of this guiding sense. At last, however, his tactile sense, and also his "muscular sense," has become so educated that he is able to do without guidance from the sense of sight; and, as a rule, he does without this primary aid as soon as the execution of the movement has become perfectly easy. Jaccoud calls the second mode of appreciation indirect, because it does not, as in the case of the sense of sight, depend upon a simple perception of transmitted sensations, but upon an interpretation of sensations. As he says<sup>1</sup>—"The sensorium requires, as a preliminary, to have learned the relations which unite the various conditions of the muscles, or of the tactile organs to the different sensations perceived; it is only at the termination of this apprenticeship that it can conclude from the sensation perceived as to the statical or dynamical conditions of

<sup>1</sup> *Loc. cit.*, p. 601



the parts whence the sensation springs. This education proceeds correctly, by means of the direct appreciation, through the sense of sight, thanks to which the individual can compare at each instant the movement effected with the sensation perceived." After this preliminary education has been finished, the knowledge so acquired, though inferential, becomes as available and as efficacious as that which is more directly derived through the sense of sight. It can be brought into action also with just as much rapidity and exactness, so that the sense of sight is no longer needed to inform us as to the position of our limbs, and as to the nature and degree of their movements.

Jaccoud, therefore, thinks that the power which healthy persons enjoy of performing, with facility, movements that are at the same time habitual and complex depends, in the first place, upon the integrity of their "muscular sense," and in the second, upon that of their sense of touch. Impressions are derived through both these channels, whereby the brain becomes informed as to the amount and kind of movement which it has called into action; and so it learns whether, to obtain the end in view, it should continue with the same kind of volition, or whether this should be qualified in any way.

When we commence a movement, we initiate it with certain pre-determined qualities of force and extent; and this, of course, is simply a result of our past experience and education. I know that certain objects have hitherto given me certain impressions of weight when I have previously handled them, and therefore my previous education now enables me, when I see such an object again and desire to handle it, to give the volitional act its necessary qualifications. This power has been termed "*l'instinct locomoteur*," and "*conscience musculaire*." It has been made the subject of much mystification, though it is a simple result of our capability of recalling in idea the kinæsthetic impressions which have previously been associated with given sight impressions—that is, the sight impressions immediately recall their related kinæsthetic impressions. When I see a simple bundle of wool on a table, as a result of previous experience, I can at once nearly accurately determine what ought to be the quality of the volition necessary to enable me to raise it. Thus I am enabled to initiate such a movement as I deem appropriate. But supposing, in the case just cited, that the supposed simple bundle of wool was not a simple bundle, that it contained a heavy leaden weight in its centre, then my initial volition would have been inadequate, I should have been deceived, and the kinæsthetic impressions that I received would have instructed me



that a stronger volitional effort was necessary. It is always in this way that kinæsthetic impressions are supposed to intervene.

By a supposed "locomotive instinct" (or, in other words, ideal recall of kinæsthetic impressions), we know, as Jaccoud puts it, *what force we ought to employ*, whilst by the actual occurrence of kinæsthetic impressions we are taught *what force we have employed*.

I have now for some time advocated such views as these, and have maintained that the immediate execution of voluntary acts, in the case of the majority of limb-movements, is dependent upon the guidance of co-active visual and kinæsthetic centres; just as in the case of the complex movements concerned in articulate speech, the immediate execution of such movements is dependent upon the regulative activity of combined auditory and kinæsthetic centres.<sup>1</sup> The latter movements seem, in short, to be related to the auditory centres, in just the same sort of way that movements of the limbs are related to the visual centres.

Where the movements which it is desired to execute are complex and difficult and we have to learn them by imitation of the movements of other persons, the sense of sight is doubly brought into action. It is necessary at the commencement, and during the continuance of our efforts, to copy such movements, to look alternately at our model and at our own moving members. A long time and much practice is, in fact, required before a person who is learning to play upon some musical instrument is able to execute the necessary actions without the aid, from moment to moment, of guiding visual impressions. During the process of learning, therefore, the visual centre evidently exercises a dominating influence.

In time, however, the impressions pertaining to the "sense of movement" (which are, of course, always associated with those of sight) become, by way of newly organised channels, sufficiently well associated with the newly organising motor mechanisms to permit the new movement, whenever it has been initiated, to be continued under the immediate guidance of kinæsthetic impressions only—that is, without further necessity for a conjoint direction through the sense of sight.

The same different tracts of the brain that are called into simultaneous or immediately successive activity for the initiation of any set of voluntary movements, would probably remain in activity during the continuance of such movement, though not exactly in the same relative proportions. Thus, if we suppose the centres specially called into activity, as guiding centres, to be the

<sup>1</sup> *Brit. Med. Journal*, April 1869, and *The Brain as an Organ of Mind*, p. 555, and chap. xxix.



visual and kinæsthetic, it may well be that the former has a dominating influence in the production of the initial conception of the movement about to be executed. And yet the distinctness of this idea or conception of the movement (partly visual and partly kinæsthetic in its origin, as we have said) will be found to vary with the degree of familiarity, and consequently with the ease of execution, of the movement. In the case of the simplest voluntary movements, or those that have been often repeated, an idea or conception of the movement needed scarcely obtrudes itself at all as a conscious element of the volition. This is a part of the process which has here become more or less latent, and which in *ideo-motor* and *sensori-motor* actions has become wholly latent; though it probably still remains, even in these latter, as a necessary link in the chain of causation. On the other hand, during the continuance of voluntary as well as of almost all varieties of automatic movements, it seems clear that the kinæsthetic centres exercise the supreme guiding influence. Its impressions alone—even when they very imperfectly, or not at all, rouse our consciousness as to their existence—suffice to inform us (that is, suffice to excite their proper cerebral "centres" in ways definitely related to different positions and muscular tensions) as to the exact relations of our limbs, and as to the nature and degree of their movements.

The mode of acquisition above indicated seems well to accord with our other interests and with the daily necessities of our lives. The sense of sight greatly facilitates the process of learning, and its vivid impressions speedily enable the brain to appreciate aright the more vague and occult impressions coming to it simultaneously through the kinæsthetic centres. Soon, however, the visual sense, which we need for so many other important purposes, no longer requires to be concentrated wholly on the performance of movements. Later still, our attention or consciousness becomes further freed from disturbing details connected with movements. The possibly conscious impressions pertaining to the "sense of movement" at last habitually pass unheeded, and then we come to be able to perform multitudes of daily actions under the guidance of mere "unconscious" kinæsthetic impressions.

Thus the working of the motor side of our complex nervous mechanism, even when it is concerned in executing the behests of will, proceeds so smoothly, and is practically so much unheeded, as to leave us free to follow up the threads of our conscious life unhindered by the multitudinous details pertaining to the varying states of innumerable muscles acting in ever-changing combinations.

From what has been said, it seems clear that the performance



of a voluntary act is always preceded by an idea or conception of the movement we desire to execute ; and that this idea or conception is, for ordinary movements, compounded of two kinds of past impressions, namely, those of the visual sense and those of the kinæsthetic sense. Again, it must be remembered that the kinæsthetic sense includes two different sets of impressions ; the one set (*a*) being conscious impressions derived from our moving members (proceeding from skin, muscles, tendons, and joints) ; the other being (*b*) either unfelt, or almost completely unfelt, impressions emanating from the muscles, in relation with their varying states of contraction, and therefore affording information to the brain of the most important kind. The evidence demonstrating the existence of this last set of comparatively unfelt impressions emanating from muscles, and pointing to their importance for the guidance of movements, is mainly derived from cases of diseases such as have been already cited (pp. 20, 23, and 24).

Now, in the chapter on "The Will," in his *Analysis of the Human Mind*, published more than fifty years ago, it appears that James Mill clearly appreciated the fact that the "idea of the action" to be performed is twofold. He says, "There are two ideas very different from one another, to both of which we give the name 'idea of the action.'" Of these, he adds, "one is the outward appearance of the action, and is always a very obvious idea." The other is a copy of certain internal sensations, which a few pages before he had spoken of generally as sensations accompanying the movement, and which he also more specifically defined (*loc. cit.*, p. 275) when speaking of the terminal events of a movement as "the contraction of the muscles, with the various sensations which the action upon those organs, and the action excited in them, imply." Of these internal sensations he says, "from the habit of not attending to them, we have lost the power of attending." And then he adds : "This last (namely, the revival of such internal sensations) is by no means an obvious idea. And the mind passes from it so quickly, intent upon the action which is its result, that it is almost always swallowed up in the mass of association. It constitutes, in fact, one of the most remarkable instances of that class of links in a chain, which, how important soever to the existence of the chain, are passed over so rapidly, that the existence of them is hardly ever recognised. . . . *This last idea alone is that upon which the contraction is consequent.*"

This view is then essentially that which I myself adopt,—viz., that kinæsthetic impressions, and especially those of which we are least conscious, are the last to be revived in the cerebral cortex, anterior to, and as actual last links in the chain of cerebral processes which determine the excitation of the motor centres themselves.



I find that since the first publication of these views, very similar notions as to the importance of revived sensations of movement for the execution of voluntary acts have been expressed by two other writers.

The views of one of these, namely Dr. E. Fournié,<sup>1</sup> were published three years afterwards; and though we do not at all agree in our general interpretation of perceptive processes, nor as to the regions of the brain concerned therewith, we are thoroughly in accord as to the importance of these sensations of movement in conjunction with other sensory impressions as guides for movements generally. Thus, he fully recognised the important part played by revived sensations of muscular contraction in voluntary as well as in instinctive movements; also the difficulty of reviving such impressions alone, when they have not been linked with visual or auditory impressions. It is true, he does not seem clear as to the mode in which such revived sensations of movement come into play, though he firmly believes that conjoined sensory impressions are the true cerebral co-ordinators of movement, and that by the aid of these alone we are enabled to learn new movements. He holds that sensations telling of the state of contraction of the muscles are "indispensable conditions in order that each movement may be directed in a suitable fashion," and says that, but for our power of recalling in idea or reviving such impressions, new movements could never be perfectly learned, so that the "execution of movements would be an eternal apprenticeship."

But much more important and more generally in accordance with my own views are the statements made by Dr. W. James. He says<sup>2</sup>:—"The essentials of a voluntary movement are—(1) a preliminary idea of the end we wish to obtain; (2) a '*fiat*'; (3) an appropriate muscular contraction; (4) the end felt as actually accomplished. In man, at any rate, it is admitted that the idea of the end and the muscular contraction were originally coupled by empirical association; that is to say, the child, with his end in view, made random movements till he accidentally found one to fit. This movement awakened its own characteristic feeling, which thenceforward remained with him as the idea of the movement appropriate to that particular end.<sup>3</sup> If the man should acquire a million distinct

<sup>1</sup> *Physiolog. du syst. nerveux*, 1872, pp. 291, 360, 362-5, 447.

<sup>2</sup> *Loc cit.*, 1880, p. 5.

<sup>3</sup> In a note further on Dr. James calls attention to an important point. He writes (*loc. cit.*, p. 9):—"I may add that in teaching a new and unnatural movement, the starting point is to awaken by its passive production a distinct sense of what the movement, if effected, would feel like. This defines the direction of the exertion the pupil is to make."



ends, he must acquire a million such motor ideas and a million connections between them and the ends. But one such connection, subserved by an exclusive nerve tract used for no other purpose, will be enough for each end. The end conceived will, when these associations are formed, always awaken its own proper motor idea. As for the manner in which this idea awakens its own proper movement—the one which will convert it from an idea into an actual sensation—the simplest possible arrangement would be to let it serve directly (through its peculiar neural process) as a stimulus to the special motor centre, the ultimate sensible effect of whose discharge it prefigures and represents.” Again, he says:—“If I will to write ‘Peter’ rather than Paul, it is the thought of certain digital sensations, of certain alphabetic sounds, of certain appearances on the paper, and of no others, which immediately precedes the motion of my pen. If I will to utter the word ‘Paul’ rather than Peter, it is the thought of my voice falling on my ear, and of certain muscular feelings in tongue, lips, and larynx, which guide the utterance. All these feelings are afferent, and between the thought of them, by which the act is mentally specified with all possible completeness, and the act itself, there is no room for any third order of mental phenomena; except indeed what I have called the fiat, the element of consent, or resolve that the act shall ensue. This, doubtless, to the reader’s mind, as to my own, constitutes the essence of the voluntariness of the act.”<sup>1</sup>

But the so-called “fiat” has no particular mystery about it. It is the mere result of the fact that one out of the two or more motives which weigh themselves against one another is, after little or much deliberation, recognised to be stronger than the others; the result being that the molecular movements with which it is associated are permitted to flow over into motor channels so as to evoke the fitting muscular actions. As James says:—“In our bed we think of the cold, and we feel the warmth and lie still, but we all the time feel that we can get up *if we will*. The difficulty is to will.” In the

<sup>1</sup> In regard to the nature of this “fiat” we may say with James Mill that it is simply equivalent to a *desire* sufficiently strong to be immediately operative (see *The Brain as an Organ of mind*, p. 550). Hartley said also, “The Will is, therefore, that desire or aversion which is strongest for the present time.” Which mental mood is to prevail is sometimes immediately settled, and at other times only after a process of Deliberation. Concerning this process Hobbes said:—“The whole sum of desires, aversions, hopes and fears, continued till the thing be either done or thought impossible, is what we call *Deliberation*. . . . Appetite, therefore, and aversion are simply so called as long as they follow not deliberation. But if deliberation have gone before, then the last act of it, if it be appetite, is called *will*; if aversion, *unwillingness*.”



case of emotional actions, the mere presence of the exciting idea is much more apt immediately to excite the corresponding movement, so that "the discharge of idea into movement is much more readily inhibited by other casually present ideas in the case of voluntary action, and less so in the case of emotions; though here, too, inhibition takes place on a large scale." As a result of these considerations he lays down the following important conclusion,<sup>1</sup> "*that every representation of a motion awakens the actual motion which is its object, unless inhibited by some antagonistic representation simultaneously present to the mind.*"

W. James very neatly summarises his own as well as my views on this part of the question, when he says:—"The ordinary 'voluntary' act results in this way: First, some movement produces a feeling in a reflex, or, as we say, accidental way. The movement excites a sensorial tract, causing a feeling which, whenever the sensorial tract functions again, revives as an idea. Now the sensorial and motor tracts, thus associated in their actions, remain associated for ever afterwards; and as the motor originally aroused the sensory, so the sensory may now arouse the motor (provided no outlying ideational tracts in connection with it prevent it from so doing). Voluntary acts are, in fact, nothing but acts whose motor centres are so constituted that they can be roused by these sensorial centres, whose excitement was originally their effect."

Finally, it would seem clearly to follow, from the views above set forth, that in all essential respects the cerebral mechanisms for the actual production of voluntary, of ideomotor, and of emotional movements are identical—that is to say, that the "way out" from the sensory centres in which the idea of the movement to be effected is revived, and the efferent tracts thence onwards towards the motor centres by which the movement is to be actually evoked, are, when the movement itself is similar, identically the same in each of these cases.

The sensory components of the idea of the action about to be performed are, moreover, always twofold. They either belong to the visual and the kinæsthetic orders, or else they are auditory and kinæsthetic, as in the case where speech movements are to be evoked. The cases are rare in which, with ordinary seeing individuals, we have the combination in idea of special tactile with kinæsthetic impressions. In the blind, however, this particular combination for the ideal recall of movements becomes very common.

In each case the "conception of the movement" about to be ex-

<sup>1</sup> *Loc. cit.*, p. 17.



ecuted, being a means rather than an end, does not after a time attract our attention. If this is so even with the initial guides of movement (that is, the revived visual and auditory impressions), how much more may we expect it to be the case with the revived kinæsthetic impressions, which are always less vivid. And how little even the initial guides of movement, when revived in idea, at all clearly reveal themselves to consciousness in many persons is evidenced by the fact that it is denied by Professor Stricker and some others that words are primarily revived, anterior to articulation, in the auditory centres.

It is, however, neither customary nor needful, either for thought or for action, that the several links in the chain of association by which these processes are effected should reveal themselves in consciousness. Many of the links of our thought and of our sensorial action are represented by sub-conscious nerve processes, and this is clearly the case with regard to those linked revivals of sensory activity which immediately precede and guide muscular movements. Transitions from conscious to unconscious nerve action are habitually taking place during the education of the individual and the development of the nervous system in each one of us; and yet the essential nerve actions still go on in the latter case, and none the less surely exercise their influence in evoking other nerve actions which are associated with conscious states, or in leading to the production of this or that form of movement.

### (b) *Automatic Movements.*

As we have seen, between voluntary and ideo-motor or emotional acts no really intrinsic differences exist, from the point of view of the nerve centres concerned with their production.<sup>1</sup>

Are we to hold, however, with Ferrier and others, that there are special motor centres for the performance of voluntary actions altogether apart from those by the aid of which automatic actions are performed? This is a view to which I cannot subscribe. An automatic movement is simply what was once a voluntary movement in the race from which the individual has sprung. The motor mechanisms that are now immediately concerned with its execution are precisely those which were originally linked together or "organ-

<sup>1</sup> In the first edition of his *Functions of the Brain*, Dr. Ferrier distinctly argued as though the nerve mechanisms needful for the production of voluntary movements were different from those by which ideo-motor and emotional movements are evoked. In the recently issued second edition he does not so explicitly state this view (*loc. cit.*, p. 371), nor does he clearly retract it.



ised" when such a movement first began to be effected by voluntary efforts.

The difference here, as I contend, is not with the motor centres; it lies rather with the nervous processes which precede the action of the motor centres. Thus, when eating, one swallows food by a series of automatic actions, without taking heed of the process; but I can at any time, by directing my attention thereto, and with the presence of saliva as an additional stimulus, voluntarily perform these same processes. In the one case the movements are evoked as mere reflex actions in which the medulla is the centre concerned; in the other they are evoked under the influence of volitional stimuli whose birth and starting-point is to be found in the cerebral cortex.

It is, therefore, in my opinion, a fundamental error to look for special motor centres for the production of voluntary movements of any kind—either in the cortex or elsewhere.

The cerebral hemispheres are needed for the learning of new movements which in succeeding generations of animals come to be performed in a purely automatic manner; or, we ourselves may learn movements which ultimately by dint of time and long practice may become so facile that they take their place in the category of "secondary-automatic" actions. These facts seem to me to show conclusively that, in the learning of any new movement, two processes of education (entailing the establishment of structural connections, or the laying down of new nerve routes) must take place concurrently. One must be carried on in the cerebral cortex in the way already described; whilst another must be effected by developmental processes taking place in lower centres, of the action of which we are altogether unconscious—processes which, with lapse of time and successive generations, ultimately permit such movements to occur in a purely automatic fashion, and, it may be, without any concurrent stimulus either reaching or rousing the activity of the cerebral cortex.

It has now been perfectly well established, by experiments on lower animals, that even such complex muscular actions as are required for station and locomotion may be performed in pigeons and in rabbits after the cerebral hemispheres have been removed. Here, therefore, it is clear we have only to do with a series of very complex reflex actions, carried on by means of the mesencephalic and cerebellar centres. It is true that afferent impressions of various kinds are needed for the effective performance of the very complex muscular actions required for the maintenance of equilibrium and for locomotion—there must, in fact, be the advent of proper visual impressions, of labyrinthine impressions, of tactile impressions, and above all of



"muscular sense" impressions. With the sole presence of these, however, the necessary movements for locomotion may be evoked, even though in its natural condition the animal is also in the habit of constantly inciting these same complex movements by volitional stimuli. The motor centres in action remain the same, they are merely called into play in a different manner; and in each case the actual movement, whether reflex or volitional, is evoked by stimuli starting from sensory centres.

For the execution of many other automatic movements the kinæsthetic impressions which impinge upon lower centres are thought to be of less importance than tactile impressions; yet these latter, in many cases, are the special stimuli which evoke the acts, whilst kinæsthetic impressions here also serve as absolutely unconscious guides—especially where the act is one which involves a succession of muscular movements. It must be upon the basis of information coming to the spinal cord itself in the form of kinæsthetic impressions, that, even in animals in which the cerebral hemispheres have been removed, as Goltz has shown, we may at times observe new adaptive movements called forth of a distinctly purposive type, that is, of a kind calculated to remove some unusual stimulus. This is an adaptive power which, as Dr. Ferrier admits,<sup>1</sup> the evidence compels us to concede to the spinal cord.

This kind of use to which kinæsthetic impressions are put in the case of automatic movements, holds good for movements of different degrees of complexity, and equally so whether they are evoked under the guidance of mesencephalic, of medullary, or of spinal sensory nuclei.

But by the time a new movement has been thoroughly learned by any particular race of animals, that is, after its constant repetition by successive generations of such animals, these tactile and kinæsthetic impressions to lower centres (whether they be spinal, medullary or mesencephalic), having been habitually impinging upon such centres (as well as making their way to the cerebral cortex) must have opened up direct channels of communication between such lower sensory centres and the related motor

<sup>1</sup> *Functions of the Brain*, 2nd ed., p. 118, where he says:—"By a series of ingeniously contrived experiments Goltz has shown that, even when the limbs of a frog were so fixed or placed in positions which could not have occurred in its past experience the animal, without its hemispheres, retained the power of adapting its movements in accordance with these unusual and abnormal conditions. This would indicate that if these centres are merely centres of reflex action, the reaction is that of a machine possessing in some way the power of self-adjustment."



mechanisms, so that the corresponding movements are then capable of being evoked in a purely reflex fashion, after the manner of automatic movements generally—that is, on the mere occurrence of the suitable stimulus, and without necessity for the intervention of the cerebral hemispheres. It is true that, in the majority of cases, the cortical connections with such motor centres still exist, so that the same movement may, whenever the desire is felt, continue to be evoked by a voluntary stimulus. This, as we have seen, is the condition of things with regard to the movements of deglutition already referred to, as well as for station and locomotion in many of the lower animals.

Experiments upon lower animals seem, indeed, to teach us that if we take different creatures, such as frogs, rabbits, dogs, or monkeys, we find in the first mentioned a comparatively small number of movements that are not purely automatic, and consequently a very small number of movements which are permanently interfered with by a removal of their cerebral hemispheres. In rabbits and dogs, however, we find movements more and more interfered with after removal of the cerebral hemispheres, showing, according to my interpretation of the facts, that a larger proportion of the movements of these animals are, as yet, unemancipated from the necessity of cerebral control and guidance in the manner I have indicated through sensory centres. In monkeys, again, we meet with a large increase in the proportion of movements which are still so comparatively new (for the race), as to be only capable of being evoked by stimuli emanating from the cerebral cortex. While in man, the knowledge we have acquired from the study of disease, as well as our knowledge of the infinitely diversified uses to which the human hand may minister, suffices to convince us that the influence of the cerebral cortex in the production of movements even very greatly surpasses that which obtains with the monkey.

Thus, we find in man the kinaesthetic centres, as well as the visual, auditory, and tactile centres, alike obtaining their maximum development, because of the extremely diversified uses and the complexity of the processes to which they are called upon to minister. The very fact of the greater development of all these sensory centres in man, and of the enormous number of the movements which are suggested and guided by his intelligence, probably tends to maintain movements generally in him more, and for a longer time, under the influence and guidance of the cerebral cortex, than similar movements would be in lower animals. Hence the larger amount of motor defect produced in man by certain cortical lesions, simply because these lesions destroy those sensory centres in



the cortex from which the volitional stimuli or controlling incitations immediately issue.

This is a kind of explanation which seems to me much more harmonious with all the facts than that advanced by Dr. Ferrier and others, which supposes that there are motor centres for voluntary movements altogether distinct from those for automatic movements, and that these imaginary "motor centres for voluntary movements" are situated in the cerebral cortex.

#### THE CORTICAL LOCALISATION OF "MUSCULAR SENSE" IMPRESSIONS.

We have seen that there are practically three groups of cases in which loss or defect of "muscular sense" impressions is apt to be met with:—(a) cases where there is disease in the posterior columns or posterior cornua of the spinal cord; (b) cases of cerebral hemianæsthesia, in which there is functional or structural disease in the region of the posterior extremity of internal capsule; and (c) cases which I previously spoke of as a more ill-defined group, but which I will now venture to say are cases of disease in the so-called "motor regions" of the cerebral cortex.

In regard to the precise path through the spinal cord taken by "muscular sense" impressions, nothing definite can as yet be said, beyond what has been above indicated. It is principally with some forms of locomotor ataxy, among spinal diseases, that defects of "muscular sense" are met with, therefore we suppose these impressions must pass upwards either through some part of the posterior column or else through the posterior cornua of the cord.

We are also unable definitely to trace the path pursued by "muscular sense" impressions through the medulla, pons, and cerebral peduncle.<sup>1</sup> The fact, however, that in a very large proportion of cases of cerebral hemianæsthesia no loss of the muscular sense exists, while, in other rare cases, these special impressions as well as any others that may be derived from muscles are entirely absent, tends to make it probable that in or near the posterior part of the internal capsule the channels for these impressions are gathered together in a more or less distinct fasciculus, before they diverge on their way to the cerebral cortex.

The final question that now presents itself for consideration, however, is:—What are the parts of the cortex to which these

[<sup>1</sup> The best available information on this subject is to be found in an important paper by Dr. Allen Starr, entitled "The Sensory Tract in the Central Nervous System" (*Jrnl. of Nerv. and Mental Disease*, July 1884).]



"muscular sense" impressions proceed? Can this be said to be known, or not?

In seeking to obtain an answer to this question, we ought to look for certain evidence that may be obtainable from experiments upon lower animals, and we should supplement this information by other evidence of a clinico-pathological nature derived from the effects of disease of the cerebral cortex in man, or from the effects resulting from removal of portions of the cortex on account of disease in this situation.

*Evidence obtainable from lower animals.*

What information may we fairly seek to obtain on this subject from experimentation upon the lower animals, and especially upon monkeys? From what has been said as to the functions of the "muscular sense" centres in the cortex in reference to voluntary movements generally, it seems obvious that they must be divided into two classes, from the point of view of the degree of their relationship to the activity of the cerebral cortex. Thus we have:—

Class I.—Voluntary actions in the largest sense of that term, among which we would include all those movements of varying degrees of facility (that is ranging from new difficult movements, to those of ideo-motor type) which cannot be executed apart from cortical instigation and guidance proceeding from the opposite cerebral hemisphere.

Class II.—Actions that are only at times incited voluntarily (that is, by incitations from the cerebral cortex), but which are, in the great majority of cases, evoked by the reflex activity of lower centres as true automatic movements.

It is necessary to bear this distinction in mind because, as will be seen, the results of destruction of the "muscular sense" centres in the cerebral cortex on the one hand, and of their stimulation on the other, should be different for the two classes of movement.

Supposing, for the sake of argument, we have *destroyed* the whole of the "muscular sense" centres of one hemisphere (the centres through which, in all actions that are performed voluntarily, the motor centres of the opposite side of the pons, medulla, and cord receive their ultimate guiding stimuli), the following result ought to ensue:—

	Classes of Movement.	Results.
<i>Destruction of "Muscular Sense" Centres in One Hemisphere.</i>	Movements of } Class I. . . }	All of them paralysed.
	Movements of } Class II. . . }	These movements not paralysed.



With practice under such conditions, and after some time, it is probable that some of the movements of Class I. which were nearest akin to those of Class II. would become capable of re-execution. They would pass indeed from the one class into the other—so that some amount of recovery from paralysis might be brought about in this way.

Now let us, in the same way, consider the effect of *stimulation* either of all or of some of the “muscular sense” centres in one hemisphere, and ascertain the effects that should be induced in regard to the same two classes of movement:—

<i>Stimulation of “Muscular Sense” Centres in One Hemisphere.</i>	Classes of Movement.	Results.
	Movements of Class I. . .	Contractions or spasms affecting the muscles by which these movements are performed.
	Movements of Class II. . .	Do. do.

*Evidence obtainable from observations on Man.*

From destruction or stimulation of the “muscular sense” centres in man, we may look for just the same kind of effects, in reference to the two classes of movement, as we have above said might be expected to occur in the lower animals. There should be a difference in degree only, dependent upon the fact of the far larger proportion of movements which, in man, belong to Class I., as compared with Class II. As a matter of fact (thanks in great part to the experimental investigations of Dr. Ferrier), we are now all familiar with the paralyses that result from destructive lesions in the Rolandic area of the cortex, and with the various forms of “Jacksonian Epilepsy” resulting from irritative disease in these same regions.

Other defects, however, may be looked for in the case of man, over and above those of which we can obtain distinct evidence from animals, as a result of destruction of his “muscular sense” centres. These are certain defects of sensibility of such a kind that it would be quite hopeless to attempt to obtain any clear and reliable evidence concerning them by experiments upon, and observation of, any of the lower animals.

It is all the more necessary to insist upon this point, because some experimenters have drawn conclusions from their observations as though it were possible to obtain such evidence from the lower animals. But, I would ask, how is it possible for us to form any trustworthy judgment concerning a blindfolded animal's knowledge (1) of the extent of the active or passive movements of one of its limbs, or of the exact position in which it may be left at the termination of these active or passive movements; or how, again,



(2) are we to judge whether the animal's ability to discriminate differences in weight or resistance with one of its limbs has suffered any diminution? These are much the most valuable means of testing the integrity of the "muscular sense," yet no evidence can be obtained in regard to either of them which is of the least value, except from an animal that has the power of speaking and telling us what his impressions are under the various trial circumstances. The only other kind of test (of less value than the two above-named because it leads to more equivocal results) is (3) the testing of the animal's ability to perform certain definite movements with one of its limbs when its eyes are closed. How difficult it must be to obtain any reliable information upon such a subject by observations upon a blindfolded animal can be easily imagined, if we look only to the limited range of movements of a suitable kind which the animal could be induced to perform under such conditions. This, however, is not the whole extent of the difficulty that we should have to face in such an investigation; there is the further complication that the limb of the animal which it would be most important to test in regard to the integrity of its "muscular sense" impressions, in the particular experiments with which we are concerned, is partially paralysed, and thus all attempts to test the integrity of its muscular sense impressions by this third and only means which is available in animals would be rendered still more fallacious and untrustworthy.

I am strongly of opinion, therefore, that nearly all the statements which have been made in reference to the integrity or otherwise of special "muscular sense" impressions, in any of the lower animals that have been operated upon, are altogether valueless,<sup>1</sup> and that we must look only to observations upon man to throw any true light upon this side of the question.

The additional defects which ought to be met with in man, however, as a result of disease of the "muscular sense" centres are of this kind. Destructive disease, or removal by the surgeon, of parts of the "muscular sense" centres should lead, in proportion to the completeness of the destruction of the parts, to a more or less marked loss of that kind of knowledge which comes from the "muscular sense" in connection with the parts of the limb that are paralysed, or the whole limb or limbs, as the case may be. In a patient in whom ordinary tactile sensibility is not much affected, if we find, after various random passive movements with eyes closed, that he cannot tell correctly the position in which his limb or fingers may be left,

<sup>1</sup> See note to p. 138.



the evidence becomes all the stronger that there must be a notable defect in the "muscular sense," because, as may be supposed, in such a case the patient may derive some guidance towards such knowledge through skin impressions. In these cases, therefore, the loss of the "muscular sense" would *always seem to be less than it really is*, and unless great care be taken it would be easy for a superficial observer to come to the conclusion that it was not impaired at all. One precaution, for instance, should always be taken. That is, the observer, after passively moving the patient's limb or fingers, must be careful not to let his own fingers remain in contact with the patient at the end of these passive movements, when he asks as to the position in which the limb or fingers may have been left. If, however, we should have our suspicions that part of a patient's ability to tell the nature of passive movements made, or of the position in which his limb is left, comes mainly from the guidance that he derives through the tactile sense, we must resort to other methods before we arrive at a positive opinion as to whether the "muscular sense" is defective or not.

In doubtful cases, therefore, perhaps the most trustworthy means of arriving at a positive conclusion as to the integrity or otherwise of this sense are these three (neither of which would be applicable, be it observed, in the case of one of the lower animals):—(a) Ascertaining whether the patient has or has not a complete knowledge of the position of the limb or limbs in question on first awaking from sleep, and before they are moved in any way; (b) Testing his ability to appreciate differences in weight with the part affected;<sup>1</sup> and finally (c) we may resort to a method adopted by Westphal (a method which is particularly useful when the part to be tested is much paralysed), that is, ascertaining when the patient's eyes are closed with what readiness, or the reverse, he may be able to bring the forefinger of the sound hand at once upon any particular part that may be indicated to him (though not touched) of the affected limb in a state of rest.<sup>2</sup> With a defective knowledge of the presence and position of a limb, the power of at once finding a particular part indicated would probably be distinctly impaired.

In brief, then, it comes to this, that if we have regard to the functions of the "muscular sense" department of the kinæsthetic centres (of which they form the nucleus or most essential part), we

<sup>1</sup> With specially charged gun cartridge cases after Galton's method, or some other equally delicate means. (See *Inquiries into Human Faculty*, 1883, p. 370.)

<sup>2</sup> [Or we may ask him to put the sound limb into the same kind of position as that in which the affected limb has been left, after passive movements.]



should expect that their stimulation would lead to spasms and convulsive movements of the parts whose motions are in relation therewith; that destruction of such centres would, on the other hand, lead to a paralysis of those movements which have hitherto only been evoked by the action of these centres; and, further, that in this latter case, there would also be a loss or marked diminution of "muscular sense" in the parts principally affected.

It will at once be seen that these are precisely the effects which have now been ascertained to follow upon the stimulation and destruction of the so-called "motor centres" in the cerebral cortex, the position of which, thanks to the successive labours of Fritsch and Hitzig, of Ferrier, of Carville and Duret, of Exner, of Horsley and Schäfer, and of Beavor and Horsley, have now been very thoroughly ascertained. The position of the centres in connection with different movements of the limbs and trunk have now, in short, been definitely localised by these various workers as well as by clinical observers, in different parts of the Rolandic area and of the marginal convolution.

My opinion, therefore, is that the evidence in our possession points very strongly to the conclusion that Ferrier's so-called "motor centres" are in reality kinæsthetic centres in which "muscular sense" impressions in particular have been registered. The following reasons lead me to this conclusion:—

1. All the effects resulting from the stimulation or destruction of these centres are, as I have already shown, in accordance with this view.

2. This being so, the view that "motor centres" exist in the cerebral cortex cannot be correct unless it can be shown that there is in the cortex of each hemisphere another totally distinct set of centres, the stimulation of which evokes definite movements, and the destruction of which involves an inability to execute the same movements. But both experimental physiology and clinical medicine speak strongly to the fact that there is but one set of areas (Rolandic and marginal) in which irritation or destruction leads to any such results. I claim, therefore, that these areas must be in great part (whatever other functions they may discharge) devoted to the registration of kinæsthetic impressions of the "muscular sense" order, which, as I have endeavoured to show, are so all-important for the production of voluntary movements.

3. No valid reasons have ever been brought forward against this view. To this it may be replied that Dr. Ferrier has carefully examined such doctrines, in the last edition of his *Functions of the*



*Brain* (pp. 379-381), and that he has there shown how much such views are at variance with existing knowledge.

The necessities of the case compel me, therefore, to be frank concerning Dr. Ferrier's position in regard to, and his treatment of, this question, to which I have given considerable attention.

According to Hitzig<sup>1</sup> the so-called motor centres are the centres for the "muscular sense" or "muscle-consciousness"; while according to Nothnagel,<sup>2</sup> though not the centres for, these regions are traversed by, impressions of this order. Both, however, adopt that lax view as to the nature of the "muscular sense" which would make it include impressions from joints, skin, etc., or, in other words, all the impressions resulting from movement, which I have grouped together as kinæsthetic impressions. Thus their views, although nominally the same as mine, are really different, seeing that I am content to subscribe to the views of Ferrier as well as of Horsley and Schäfer, to the effect that the falciform lobe (hippocampus, gyrus hippocampus, and gyrus fornicatus) is the main seat, at all events, in which tactile impressions and those of common sensibility are registered.<sup>3</sup> The convolutions in the excitable Rolandic area, together with the marginal convolution, are, however, according to my view, the seats in which "muscular sense" impressions proper (the all-important constituents of kinæsthetic impressions) are registered, and from which volitional stimuli immediately issue. Arguments, therefore, which may be valid against the views of Nothnagel and Hitzig, in regard to the non-impairment of common sensibility in cases of destructive disease of the parts in question, may be of no avail against my doctrine.

As, however, we have much in common, it may be well to scrutinise Dr. Ferrier's attitude with regard to these views as a whole (*loc. cit.*, pp. 379-381), especially as he does not endeavour to make any nice or essential distinctions between them.

Thus, he does not attempt to distinguish between the effects that might be expected to follow from loss of the "muscular sense" centres, and those which would result merely from the cutting off of the proper impressions from such centres, they themselves being left intact. Any one who has read the present paper will realise that from my point of view this is a most important distinction. In his first edition Ferrier pointed out that Nothnagel regards the cortical

<sup>1</sup> Reichert's u. Dubois-Reymond's *Archiv.*, 1870 and 1874; also *Untersuch. in das Gehirn*, p. 59, 1872.

<sup>2</sup> Virchow's *Archiv.*, Bd. lvii., 1873.

<sup>3</sup> For my present views on these questions, see Appendix C.



centres in question as "in some manner directly connected with the paths" of muscular sense impressions, while Hitzig regards them as the cortical termini for these impressions. In his second edition, he does not think it worth while to state any such distinction; he assimilates Nothnagel's doctrine to that of Hitzig, and, strange to say, assumes that the effect of the destruction of such centres would be ataxy rather than paralysis. He even repeats this as against my doctrine, saying, "It might explain ataxy, but not paralysis." This, as well as other remarks which he makes, convinces me that Dr. Ferrier has given no adequate consideration to the subject. Let me say definitely that, in accordance with my views, paralysis should result from the destruction of these centres; and that inaccurate and more or less disordered movements when the eyes are closed (ataxy) should be the effect of the cutting across of the paths of muscular sense impressions whether near the hinder part of the internal capsule or in the spinal cord.<sup>1</sup>

Ferrier, treating the question from the point of view of the mere cutting off of muscular sense impressions (which is in fact Nothnagel's doctrine, though not Hitzig's, which he is ostensibly criticising), supposes, therefore, that the resulting defects would be of an ataxic order more especially, and then goes on to say that this is, at all events, not the nature of the defect met with in the monkey or in man. Then comes the following very positive statement:—"It is also certain—and a subject of daily clinical demonstration—that in paralysis from cortical disease the patient, though unable to move his arm voluntarily, is perfectly aware of every movement passively communicated to it, and can state with exactitude whether his arm is flexed or extended, whether his fist is closed or open, and whether his finger is being flexed or extended gently or with force. His muscular sense, as well as every other form of common sensibility, is absolutely unimpaired." How very far this is from being an accurate statement, however, any one may judge who will refer to the cases which I have previously cited:<sup>2</sup> viz., the case of P. Zenner, presumably one of cortical injury, as well as

<sup>1</sup> In relation with this statement, it may be well here to recall the fact, that if a low condition of functional activity in the "muscular sense" centres should co-exist with a disease which cuts off its proper impressions from such centres, there may, in addition, be inability to perform the simplest movements when the eyes are closed (pp. 22-27); while, in other cases, with a still lower state of functional activity of the "muscular sense" centres (with or without co-existing hemianæsthesia), we should have to do with paralysis of an *hysterical type*, in which voluntary movements cannot be performed either with eyes closed or with eyes open (*Brain*, Ap. 1887, p. 36).

<sup>2</sup> See *Brain*, Ap. 1887, pp. 24-32.



the two cases recorded by V. Horsley, in which he had excised portions of the cortex. Afterwards, in his attempts to dispose of the doctrines of Hitzig and Nothnagel, Dr. Ferrier makes a series of statements which, to say the least, are, as I have attempted to show in previous parts of this paper, very insufficiently founded upon fact and actually misleading in their nature.<sup>1</sup>

In short, it seems to me perfectly obvious that Dr. Ferrier has never thoroughly thought out this portion of his subject, and that his expressed opinions have been, and still are, most inconsistent. He began, in the first edition of his justly celebrated work, by assuming that motor centres were seats in which the ideal recall of movements occurred<sup>2</sup>—though at the same time, and in flagrant opposition therewith, he strongly contended that all sensations resulting from movement reach the brain through afferent channels.<sup>3</sup> In the second edition of his work he has corrected this discrepancy. He now admits that the ideal recall of movements can only occur in sensory centres—though he appears to do all he can to explain away the importance of these kinæsthetic centres. He shows no gleam of recognition of their importance for the execution of voluntary movements.<sup>4</sup> He, indeed, expressly repudiates their influence in this direction (and the opinions of those who support such a notion) principally by means of two assertions which are almost wholly at variance with clinical teaching. Thus, he makes the extraordinary statement that loss of tactile sensibility carries with it loss of the muscular sense; and, further, that loss of the muscular sense never occurs alone, or, as he implies, otherwise than in direct proportion to loss of tactile sensibility.<sup>5</sup>

Dr. Ferrier's statements concerning the order of events in voluntary acts are, moreover, extremely inexplicit; his assumption that the mechanisms for such acts are organised in special cortical centres, rests on just as unsatisfactory a basis as does his notion that all kinæsthetic impressions are mixed inextricably with tactile impressions in one and the same cortical terminus.<sup>6</sup> As this, in fact, is a rival hypothesis, I ought to quote it in Dr. Ferrier's own words, more especially as it is all, so far as I have been able to find, that

<sup>1</sup> I mean the statements which I have quoted (*loc. cit.*) in Notes to pp. 15 and 23.

<sup>2</sup> See (*loc. cit.*) the first paragraphs of § 92, § 96, and § 98.

<sup>3</sup> *Loc. cit.*, pp. 218-228.

<sup>4</sup> *Loc. cit.*, 2nd ed., pp. 432-438.

<sup>5</sup> See *Brain*, Ap. 1887 notes on pp. 22 and 23.

<sup>6</sup> This latter conclusion is based upon deductions made from his observations upon animals.



he says throughout his work and on his own account concerning the cortical localisation of "muscular sense" impressions. After remarking that he considers it established "beyond all doubt that the falciform lobe is the centre of common and tactile sensibility," he adds<sup>1</sup>:—"In the same regions are also the centres of cutaneous and so-called muscular sensibility. . . . All the facts receive the most satisfactory explanation, if we regard the falciform lobe as a whole, and in each and every part the centre of tactile sensation for the whole of the opposite side of the body; though probably the various motor centres are each anatomically related by associating fibres with corresponding regions of the falciform lobe. This association would form the basis of a musculo-sensory localisation."

In the few remarks which Dr. Ferrier has made in regard to my views in particular,<sup>2</sup> he principally confines himself to a statement of the difficulties which he experienced in comprehending their precise meaning. These difficulties I trust he will now no longer experience; at least I have striven to explain my meaning as clearly as possible. Several of his statements concerning these views are not altogether correct, but one which he makes is extremely misleading, in more ways than one, and calls for some notice from me. He leads his readers to believe that my views should not find favour because they are based upon an old and erroneous notion that "the cortical centres act only through the corpora striata." How far this is from being a correct representation of my position the reader may judge for himself, seeing that this is the first occasion on which any mention of these basal ganglia has been made in this paper. My views are, in fact, wholly independent of any fixed notions concerning the functions of the corpora striata, as to which so much doubt has arisen of late years.<sup>3</sup>

<sup>1</sup> *Loc. cit.*, 2nd ed., p. 344.

<sup>2</sup> *Loc. cit.*, p. 381.

<sup>3</sup> This criticism comes, however, all the more strangely from Dr. Ferrier seeing that in my work *The Brain as an Organ of Mind*, 1880, I certainly could not have said anything more definite about the functions of the corpora striata than he said in the first edition of his *Functions of the Brain*, 1876, where I find the following statements:—"The cortical motor centres which necessarily act downwards through the corpus striatum" (p. 210); "The corpus striatum is the centre in which movements primarily dependent on volition proper tend to become organised" (p. 214); "In these cases, and in the dog deprived of its cortical centres, the path from impression to action is not, as in the ordinary course of volition, through the cortical motor centres to the corpus striatum, and thence downwards, etc." (p. 215). These were the statements concerning the corpus striatum which were backed by Dr. Ferrier's authority till the autumn of 1886, when the second edition of his work appeared.



*Facts which favour or oppose the Notion that the Centres in the Rolandic and Marginal Areas are real Motor Centres.*

Having adduced the reasons which induce me to believe that the so-called "motor centres" of the cortex are in reality the cortical termini of muscular sense impressions, and having discussed, and I hope shown, the futility of some of the objections which have been made to this view, I will now briefly glance (a) at the facts upon which reliance is placed by others in support of the notion that these centres are really motor, and then turn (b) to an enumeration of the strong reasons which in my opinion can be brought forward against any such hypothesis.

(a) The first facts to be considered are the results of stimulation or destruction of the regions in question.

In regard to these it will be well first of all to quote what Prof. Ferrier says. He writes as follows<sup>1</sup>:—"As regards the physiological significance of these regions, we have seen that we cannot conclude from the mere occurrence of movement on the electrical stimulation that the regions are truly motor; for the stimulation of a sensory centre may give rise to reflex or associated movements. . . . Whether the centres now under consideration are directly motor, or only give rise to movements in a similar reflex, or indirect manner when stimulated, is a question which has been answered differently by different physiologists. The definite purposive character clearly perceivable in most of the movements, however, their correspondence with the ordinary volitional activities and individual peculiarities of the animals, and above all their uniformity and predicableness, harmonise best with the hypothesis that they are the signs of the artificial excitation of the functional activity of centres immediately concerned in effecting volitional movements, *and as such truly motor*. If these centres are part of the mechanism of volitional movements, then paralysis of voluntary motion, *and of motion only*, ought to result from their destruction, and any apparent exception must be capable of satisfactory explanation in accordance with this view, if it is the correct one." This is in my opinion a thoroughly just statement in all respects except in regard to the two passages which I have caused to be printed in italics.

To the first passage so printed I altogether demur, as being a complete *non sequitur*. The movements excited might also be expected to have all the characters described by Dr. Ferrier if they were sensory centres "immediately concerned in effecting volitional

<sup>1</sup> *Loc. cit.*, 2nd ed., p. 347.



movements," viz., those in which "muscular sense" impressions are registered. It is, in fact, a rule which obtains throughout the nervous system, that all motor centres whatsoever are always stimulated into activity through incitations coming from sensory centres or nuclei, consequently the electrical stimulation of such centres or groups of cells, or of the fibres issuing from them, should always evoke just such movements as the excitation of these centres or cells is accustomed to produce. Similarly, destruction of such centres or nuclei should render impossible all such movements as had previously been evoked by their agency as necessary factors.

Secondly, if "these centres are part of the mechanism of volitional movements," and if they subserve such functions as I have imagined, the second passage which has been underlined would also be altogether wrong; their destruction, in that case, would involve not only paralysis of voluntary motion but also loss of the so-called "muscular sense" in the related parts.

So far, then, here is nothing which may not be explained by my hypothesis with just as much ease as by the more fashionable notion. We come, however, now to another set of facts which are pointed to triumphantly by Ferrier and his adherents, as a crowning proof of the truth of their notions, viz., to the fact that the study of descending degenerations in the pyramidal tract conclusively shows that efferent fibres pass continuously from the centres in the Rolandic and marginal areas downwards to motor centres in the medulla and throughout the whole length of the spinal cord.

To this I reply that the direction of secondary degenerations affords good evidence as to the efferent or afferent functions of the nerve fibres which are so affected, and that our present knowledge shows conclusively that the fibres in the pyramidal tract are efferent fibres—a notion which I hold equally with Dr. Ferrier. This, however, does not at all touch the question whether the ganglion cells which exercise a trophic influence upon such efferent fibres form constituent parts of sensory or of motor centres, which is the real question in dispute. If this trophic influence is a mere collateral incident of the functional activity of the cell, as is now generally supposed,<sup>1</sup> then it must always be exercised in the direction taken by currents starting from the cell, so that the fact that secondary degenerations in the pyramidal tract pursue a descending course merely tells us that we have to do with efferent nerves, and absolutely nothing as to whether the trophic cells from which they issue belong to sensory or to motor centres.

<sup>1</sup> And as Dr. Ferrier himself imagines (*loc. cit.*, 2nd ed., p. 85).



The direction of the degeneration says nothing, therefore, which is more in favour of Ferrier's than of my hypothesis.

Again, the fact that these pyramidal fibres pass directly downwards from the centres in question in the cerebral cortex, to groups of motor cells situated in the pons, the medulla, and throughout the spinal cord, is a point which tells no more in favour of the one hypothesis than of the other.

Thus, it is an essential part of my general view (which I stated so long ago as 1869) to suppose that the elementary motor mechanisms which are called into play in voluntary movements are the same, and no other, than those which have to be called into action in corresponding automatic movements (see p. 155). This view has lately been strengthened by some valuable experimental researches of Ferrier and Yeo, concerning which the former says<sup>1</sup>:—"The stimulation of each motor root of the nerve plexuses of the limbs in monkeys, calls forth combined movements involving the co-operation of numerous muscles, widely separated from each other anatomically, but all resulting in actions such as are seen to be constantly associated together in the ordinary modes of activity of the animal." After giving illustrations of this Ferrier adds:—"These facts render it probable that each segment of the cervical and lumbar enlargement of the spinal cord, whence nerves proceed to the limbs, is a centre of co-ordinated synergic muscular movements, of a character adapted to the habits and requirements of the animal in its ordinary modes of activity." Ferrier's recent work, therefore, gives a positive basis of support to the view which I had previously enunciated, and have more lately reiterated,<sup>2</sup> though it seems to me to tell rather against his notion that there are separate motor centres in the cortex, on the ground that the spinal mechanisms merely require excitations from the cerebral cortex in order to evoke purposive movements.

Either view as to the functions of the cortical centres would still, and equally, leave in doubt the question whether or not other centres in any way co-operated with these and the medullary or spinal centres in the bringing about of new and complex voluntary acts. Of course we know that, where station and locomotion are concerned, the cerebral incitation must be in part devoted to a rousing of activity in the conjoined mesencephalic and cerebellar centres. Again, supposing the thalamus and corpus striatum to constitute a higher couple still for the performance of acts which are not voluntary, as Dr. Ferrier suggests, we may ask what are the efferent

<sup>1</sup> *Loc. cit.*, p. 76.

<sup>2</sup> *The Brain as an Organ of Mind*, 1880, p. 558.



fibres through which these centres act upon those below, and we may put the same question in regard to the combined mesencephalic and cerebellar centres. Such questions become all the more pertinent if applied to the case of a dog which has had its so-called "motor centres" removed from both hemispheres, and which, if it should live long enough, as in Carville and Duret's experiments, would presumably have secondary degenerations throughout both pyramidal tracts. Yet in such animals after a time both station and locomotion become possible.<sup>1</sup> Here, therefore, the incitation of all the motor nuclei needful for the accomplishment of the complex muscular contractions occurring during locomotion must take place through channels other than those pertaining to the degenerated pyramidal tracts. I make these latter remarks merely for the purpose of indicating how much we still have to learn upon this whole set of questions, and not with the view of showing that such difficulties press more heavily upon the one than upon the other of the two hypotheses now being weighed in the balance.

The above-mentioned are the only real grounds that have ever been put forward in support of the notion that the centres in question in the Rolandic and marginal areas of the cortex are true "motor centres."<sup>2</sup> What has been said above, however, clearly shows that the facts admit of a totally different interpretation. If we put aside for the moment the question whether the "muscular sense" is or is not impaired or lost in limbs, less or more paralysed from lesions occurring in these portions of the cerebral cortex, all the remaining facts are, to say the least, fully as much in accordance with my view as with that of Dr. Ferrier. If, however, subsequent observations on man should confirm what the observations of Horsley and Zenner render possible, or even probable, that loss or impairment of the "muscular sense" will be found to exist in the paralysed parts in cases of cortical disease, then the balance of evidence would be completely turned in favour of my hypothesis, that these Rolandic and marginal centres are the cortical termini for "muscular sense" impressions. This would be crucial evidence which could not be gainsaid even by the most sceptical, since as Dr. Ferrier himself puts it, in accordance with his view that the above-mentioned cortical centres are true motor centres, "paralysis of voluntary motion, and of motion only, ought to result from their destruction."

<sup>1</sup> Ferrier, *loc. cit.*, p. 367.

<sup>2</sup> The mere large size and other peculiarities of the nerve cells in these regions of the cortex may be explained by the one as well as by the other hypothesis, if we look to the nature of the stimuli issuing from them, and to the length of the paths which such stimuli would have to traverse.



(b) So far, however, I have only been discussing the value of the evidence which its supporters put forward in favour of their notion that the cortical centres above indicated are true motor centres; it still remains for me to state what can and ought to be said against the notion of the existence of any such centres in the cerebral cortex. Whilst, in fact, the additional evidence from observations on man, alluded to above, may be needed to convince the strongest partisans of the "motor" hypothesis as to the truth of my particular view, I trust many persons may be found to agree with me that, even in our present state of knowledge, the following considerations are amply sufficient to show, not only that there is now no independent foundation for the hypothesis that "motor centres for voluntary action" exist in the cerebral cortex, but that such an hypothesis is in reality repugnant alike to physiological and to psychological data.

The theory which first led to the postulation of the existence of such centres by Dr. Hughlings Jackson has been thoroughly disproved, and nobody admits this more fully than does Dr. Ferrier himself. Hughlings Jackson has always strongly supported the view of Bain as to our feelings of movement being "concomitants of the outgoing current," and that such feelings are ideally revivable in motor rather than in sensory centres. The logical corollary of these views is, undoubtedly, that motor centres should exist in the cerebral cortex. As we have seen, Dr. Ferrier has, one by one, renounced these fundamental doctrines as erroneous, and yet he still clings to a theory which is the natural associate of such rejected doctrines. His position is, therefore, a very inconsistent one.

The supposition that motor centres exist in the cortex for the performance of voluntary movements is, however, thoroughly repugnant in itself to what we may term the physiologico-psychological analysis of the volitional act. This teaches us that sensory centres are the real guides of volitional action; that their activity corresponds with the very essence of volition; that they, in fact, do just such work as that which those who do not adequately think out the problems involved attribute to cortical motor centres.

Ferrier's view is equally repugnant to the physiology of movements from an evolutionary standpoint, which teaches us that the selfsame motor mechanisms that are at first called into play volitionally (that is, by incitations from cortical sensory centres), become, with lapse of time in new generations of animals, the motor mechanisms for corresponding automatic acts. Ferrier's view that the centres in the cortex are motor expressly says that they are for the accomplishment of volitional acts only; and at the same time he tells us nothing as to how this assumed registration of voluntary movements,



in regions altogether distinct from those in which automatic movements are registered, can be reconciled with the fact that every sort of transition exists between voluntary and automatic movements, and that many of the selfsame movements are at times executed volitionally, though at other times they are performed as typical automatic movements. If he does not mean to say that the voluntary acts are registered in the cortical centres as actual motor mechanisms, then I maintain that, in consequence of an imperfect analysis of the phenomena of volition, he is simply attributing to assumed motor centres that guiding action which is really carried on in sensory cortical centres.

Finally, there is only one complete set of excitable areas in the cortex of each hemisphere (through which movements may be evoked in all parts of the body), but if Dr. Ferrier's views were true there ought to be two complete sets of such excitable centres in each hemisphere. Clearly and indubitably the sensory incitations to movement, constituting (as all admit) part of the volitional act, *must pass off from certain cortical areas in a definite and orderly manner in order to excite motor centres, wherever they may be situated.* I assume that they pass off in such fashion from the cortical termini for "muscular sense" impressions. The stimulation of these centres or efferent fibres, which must exist, should, therefore, clearly be capable of evoking purposive volitional movements. All those who, contrary alike to the teachings of psychology and of physiology, would look for separate volitional motor centres in the cerebral cortex must seek to discover therein another distinct set of excitable areas. Perhaps it might be easier and more conducive to sound doctrine for them to reconsider the whole question.

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For all the reasons which have been above set forth, therefore, it seems to me to be a matter of extreme importance to recognise that the excitable areas in the Rolandic and marginal regions of the cortex are in no proper sense of the term "motor centres," and that the evidence at present in our possession makes it extremely probable that they are termini for kinæsthetic impressions derived from muscles, so that their excitation in this or that region is the immediate precursor of this or that kind of voluntary movement.



## APPENDIX B.

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### ON THE NEURAL PROCESSES UNDERLYING ATTENTION AND VOLITION.<sup>1</sup>

IN the address which in accordance with custom it will be my duty to submit to you to-night I purpose saying something concerning the neural processes underlying two endowments which are to be found at the root of all our mental and bodily activities. They are endowments naturally obscure and difficult to understand, concerning which great differences of opinion exist both among psychologists and neurologists. I allude to the processes of Attention and Volition. It is still not uncommon for them to be regarded as separate and mysterious 'faculties,' in the old sense, and to find those who hold such views seeking, in the same spirit, to enthrone them in some definite centres in the cerebral cortex. It is the process of attention more especially that has given rise to an enormous amount of discussion during the last quarter of a century. Previous to this period no very great diversity of opinion existed in regard to this mental endowment, or as to the complicacy of the processes with which it is associated; but the promulgation of the doctrines of Wundt and Bain in regard to 'feelings of effort' as concomitants of the activity of motor centres or of the outgoing current, followed as it was soon afterwards by the postulation and supposed location of true 'motor centres' in the cerebral cortex, speedily led to the enunciation of many new views concerning attention, perception, volition and other psychical processes. The brilliancy and importance of the experiments which led to the discovery of the centres in question, combined with the popular view of their interpretation, undoubtedly tended to foster the spread of the parent doctrines.

Now, however, when the fundamental doctrines of Wundt and

<sup>1</sup> Being portions of a Presidential Address delivered to the Neurological Society of London, on January 29, 1892, which appeared in the April number of *Brain* and in that of the *Revue philosophique*.



Bain in regard to the nature and origin of the feelings of effort are believed by many to be absolutely disproved;<sup>1</sup> and when the derivative notion that 'motor centres' exist in the cerebral cortex has also, in the opinion of many, been shown to be almost similarly improbable, it seems an opportune moment to look beyond, and inquire as to the validity of the foundations for some of the new doctrines concerning attention and volition, which are also to be regarded as, in great part, derivatives of the fundamental notions above referred to.

It is clear that the two processes of attention and volition have so much in common that there must be a certain community of interpretation both from the psychological and from the neurological point of view. It is not likely, that is, that one process could be explained correctly from the old and the other from the newer point of view. If these newer views are untenable in the one case, they will be similarly unfit for the explanation of the related psychical process.

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#### ON THE RELATIONS EXISTING BETWEEN ATTENTION AND VOLITION.

Both attention and volition are in part feelings of a so-called 'active' type; the exercise of each of them being associated with a 'feeling of effort.' Attention is the more primordial endowment; and volition is in part a development therefrom, in which, however, the root process is easily to be detected.

Attention may be directed to impressions made by things without—that is to sensations; or to their revival in idea—the latter mode of activity being known as 'reflection.'

Attention itself is commonly held to mean a "concentration of consciousness." The more our consciousness is narrowed and focussed, as it were, upon some one object or thought, the more developed is that state of mind known as attention. On the other hand, the wider the area of consciousness at any given moment (the larger the number of objects or ideas simultaneously present), the less vivid is our state of consciousness, the less developed is that phase of mind known as attention. This mode of activity is, however, named 'apperception' by Wundt.<sup>2</sup> The entry of an object into

<sup>1</sup> Of Wundt only as regards his supposed 'feelings of innervation'; as he admits that one part of the feeling of effort is of afferent origin.—*Psychologie physiologique*, 1886, t. i., pp. 421 and 445.

<sup>2</sup> According to Prof. Cattell (*Mind*, vol. xiii., p. 438) the word 'apperception' was introduced into philosophy by Leibnitz to denote a spontaneous activity



the field of vision he speaks of as perception; but when it becomes the object looked at—the central point—there is what he calls apperception, or, as others would say, a process of attention.<sup>1</sup> With this process there is always a particular feeling of effort associated. He agrees, in fact, with Fechner in saying that there is always a feeling of tension in the sensorial organs corresponding with an act of external attention, while with an act of internal attention (reflection) there is a similar feeling referred to the scalp, especially in the occipital region.<sup>2</sup>

But attention varies in its degree of complexity; it is simple or 'spontaneous,' for instance, when we are exposed to some very vivid or novel sensorial impression, or when there is the memorial recall of some extremely painful or pleasurable incident. Attention is usually rendered, under such circumstances, as it were automatically and without effort—and, as Ribot insists, in response to some emotional state.<sup>3</sup> On the other hand, attention may be initiated in a more complex manner, as in those cases where it seems to be indissolubly associated with an act of will or volition. This is the higher phasis known as 'voluntary attention'; it is the process by which we compel ourselves to observe certain external phenomena, not of absorbing interest in themselves, but for some ulterior purpose; or in which we direct our thoughts upon a given subject with a view to develop our knowledge of its relations.

Voluntary attention appears to be a compound or fusion of the two states, volition and attention. This seems all the more clear when we remember the two spheres of will long ago indicated by Locke. The direction of our thoughts is, in fact, as much a mode of volitional activity as is the production or the control of movements in predetermined modes. Nay, more, it happens that the psychical process preceding the production of all voluntary actions whatsoever differs little, if at all, in its essential characters from that which is comprised in an act of voluntary attention (Wundt). Anteriorly, however, there is in volition another important process; there is more or less of a weighing of motives prompting to this or that kind of action—that is, of deliberation. This deliberation terminates in the dominance of one or other of the motives under consideration, and with this there is generally associated the idea

of the mind through which presentations are clearly distinguished. The word was also made use of by Kant and by Herbart, previously to the time when Wundt assigned such a prominent place to it in his psychology.

<sup>1</sup> *Psychologie physiologique*, 1886, t. ii., p. 231.

<sup>2</sup> See also Ribot, *The Psychology of Attention*, Chicago, 1890, pp. 22, 67-69.

<sup>3</sup> *Loc. cit.*, pp. 12, 16, and 32.



of some action to be performed now or at some future date. This dominance, therefore, makes more vivid the idea of its particular associated movement or series of movements. Coincidentally, if there is to be present action, there is the removal of all 'inhibition,' and the ideal movement becomes immediately replaced by the actual movement which it prefigured. As to this latter process Hume said<sup>1</sup>:—"But the means by which this is effected; the energy by which the Will performs so extraordinary an operation; of this we are so far from being immediately conscious, that it must ever escape our diligent inquiry." To this prognostication we may, I think, fairly demur. Our knowledge of the functions of the Rolandic area, and of its relations through the pyramidal system of fibres with motor centres in the bulb and in the cord, does, in part, redeem us from this reproach of hopeless ignorance.

### ATTENTION.

In reference to Attention three problems seem especially worthy of consideration:—[1] as to the essential nature or mode of production of the process of attention; [2] as to the exact relation of attention to motor activity, and as to its intensification or diminution thereby; [3] as to the cerebral seat or mechanisms concerned with this endowment.

Under one or other of these heads most of the principal difficulties or differences of opinion in regard to attention may be discussed.<sup>2</sup>

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With most of these statements and points of view I have myself no sympathy. As will have been seen, I take a totally different view as to the relations of the centres concerned with turning of the head and eyes to the process of attention from that adopted by Ferrier, nor can I regard attention, whether called by its own name or by that of 'apperception,' as a 'faculty' which, somewhat in the old phrenological sense, is to be definitely localised in this or that portion of the cortex; and least of all could I think, if it is to be topographically localised, that we should place this essentially sensorial endowment in that region of the brain which may, truly enough, be concerned with the production of one of its commonest motor accompaniments or reactions. The reason why there must necessarily be such motor reactions and accompaniments is, as I have said, dependent in part upon the constitution of our nervous systems, and in part upon the fact that we are compelled to react by

<sup>1</sup> *A Treatise of Human Nature*, 1737.

<sup>2</sup> Almost all that was said concerning 'attention' has been here omitted.



turning the head and eyes in this or that direction, because from all sides visual and auditory stimuli may come to us. The relation between these particular movements of the head and eyes and attention do not, therefore, convince me that they are other than almost necessary results of sensorial activity. On the other hand, I should not think of attempting to localise the process known as attention in any one definite part of the brain, but should regard it as having its loci in cell and fibre mechanisms in each one of the cortical sensorial centres—that is, as being concerned with mechanisms scattered all over the cortex, according as we are, with more or less predominance, attentive to visual, auditory, tactile, olfactory, gustatory, or kinæsthetic impressions.

### VOLITION.

As already intimated, the sphere of what is called Volition is commonly believed to be two-fold. Thus, one form of such activity is supposed to exist which manifests itself in the control or guidance of our thoughts; and another in the production of muscular movements. These two processes correspond with what Wundt terms the “internal and the external activity” of Will. What really happens in these two cases we must now consider.

In the first place it is necessary, here also, to get rid of the erroneous notion that under the head of Will or Volition there is to be included a distinct ‘faculty’ having a cerebral localisation of its own in some part of the cortex—an imaginary ‘faculty’ acting as a well-spring of power, isolated and mysterious in its origin. Still less can we believe that Will is “a species of spiritual rudder distinct from and superior to the automatic forces of the brain.”<sup>1</sup>

According to Bain the external and the internal modes of activity of will are essentially similar; he holds that in each case the fundamental action is through motor centres and muscles, and his view has been adopted by Ribot and others.<sup>2</sup>

Bain says<sup>3</sup>:—“I look upon volition as existing only in connection with the active organs, that is, with the muscular system. Even in the sphere of thought the limitation holds.” For Wundt, James and others, also, any difference that might be thought to exist between the two processes is more apparent than real. They, however, differing from Bain, regard as fundamental the nervous processes that occur anterior to the actual incitation to the movement—

<sup>1</sup> *The Spectator*, June 6, 1891, p. 793.

<sup>2</sup> *Loc. cit.*, p. 51.

<sup>3</sup> *The Senses and the Intellect*, 3rd ed., p. 559.



holding, as they do, that the activity of muscle is a non-essential and mere physical addendum to the volition itself. As Wundt points out, in certain cases of paralysis the will to move may be present and exercised—even though the movement does not follow.<sup>1</sup>

*The Nature and Extent of Voluntary Power over the Control and Direction of our Thoughts.*

That we have some power of controlling or directing the succession of our thoughts is generally recognised, and confirmed by the consciousness of each one of us. It seems obvious, also, that this aptitude may not only be improved by practice, and that it is naturally much better developed in some persons than in others—and especially in those whose powers of attention are strong.

In all such processes of direction or control of thought we have the manifestation of the highest phase of attention—that known as ‘voluntary attention’—the consideration of which was previously postponed till the present stage of our inquiry was reached; so that what is now to be said will bear as much upon the subject of voluntary attention as upon volition proper.<sup>2</sup>

I must take it as commonly admitted that the succession of our thoughts depends upon what is known as the ‘association of ideas’; and that these associations are but reflexes of the sequences and co-existences obtaining among the various sensorial impressions to which we are and have been from moment to moment exposed

<sup>1</sup> As to the psychological characteristics of the two modes of volitional activity (internal and external) Wundt (*loc. cit.*, t. ii., p. 445) contends that there is a feeling of internal activity or effort associated with each of them, but in cases of the latter type where movements follow, he says, “this feeling receives here a characteristic colouration because it becomes fused with the sensations of the movement itself, so as to constitute an inseparable complexus.” The birth of this fusion becomes, therefore, for Wundt, the fundamental basis by which ‘external voluntary activity’ is to be distinguished psychologically from ‘internal voluntary activity.’

<sup>2</sup> What is now to be said may constitute an answer, in fact, to those who still believe in the spiritual conception of Will. Thus a writer in *The Spectator* (June 6, 1891, p. 789) has said that “voluntary or scientific attention” is “an act of pure *will*, meaning by will, of course, not that which is the resultant of pre-existent impulses and desires, but that self-caused effort by which scientific attention is distinguished from all such acts of involuntary attention. . . . We know nothing if we do not know that we ourselves cause for ourselves all such acts of attention, and that science of all kinds is the organised result of such acts. . . . As we said last week, ‘will’ is a word of supererogation, it is a will-o-the-wisp which has no pretence for existing at all, if it represents nothing but a resultant of desires.” Yet that this latter view is true, we shall now endeavour to show.



throughout our whole lives. Thus the mind of man is, as Leibnitz called it, a 'mirror of the world,' so far as it is revealed to each dweller thereon.

Again, it is well understood that for the purpose of influencing or altering trains of association, the power of direct impressions is more potent than that of mere remembered impressions. Consequently, when we are in the midst of a train of abstract thought, any vivid impression coming to us from without will tend to arouse associations of its own, and thus disturb our previous trains of mere reminiscence.

If the subject on which we are thinking is associated with external observation, the one or two senses concerned are of course active, and receptive, and the vivid impressions that we receive through them suffice to fix our attention and control our thinking processes. If we wish to divert our attention from either of these vivid sensations, so as to be enabled to follow some other line of thought, we can avert our eyes, or close our ears, so as to cut off the disturbing impressions. In abstract thought we often naturally close our eyes, court silence, and keep perfectly still, so as to have no externally derived impressions of any kind disturbing our trains of association.

We are concerned in all such cases with mere reminiscence or memorial recall of past impressions, together with intellectual activities related thereto. During such a process portions of almost the whole of the cortex may be maintained in a condition of full or sub-conscious activity as, with "the rapidity of thought," molecular notions pass along countless definite lines or associating channels between this and that group of ganglion cells. The nervous activity tends in each case to pass most and with greatest ease along those channels which have hitherto been most frequently traversed—taking the routes, that is, which custom has rendered "lines of least resistance." As an able writer says: "In this way trains of thought of any length may be excited; until the original nervous activity either emerges by some form of expression into the outer world, or becomes absorbed in the stronger current of a fresh direct sensation."<sup>1</sup>

Thus it is found that our thoughts invariably follow one another by the laws of habit or association (these being, as I have said, a reflex of external co-existences and sequences), the most vivid sensation or idea for the time being ever filling our consciousness and rousing, through associational channels, related ideas and concepts. So that the continuance for a time of any one of them

<sup>1</sup> Barret, *Physical Ethics*, 1869, p. 315.



merely proves that during the period of such continuance there is no other strong enough to drive it out.

If, therefore, our thoughts succeed one another in this way according to definite laws, it may be asked (*a*) what is the province of volition or will in regard to their direction, and (*b*) by what means can any such influence be exerted?

(*a*) As to the first question I believe nothing more definite than what Barret expresses in the following passage can be said.<sup>1</sup> "We may, indeed, if we like, give to those sequences in which one train of thought *supersedes* another the name of 'will,' as distinguished from those which are regular members of one continued train; but their nature and foundation must be the same in the one case as in the other; for the second train must have some origin like the first, and can only conquer by its superior force." It comes, in fact, to this, that our thoughts invariably occur in accordance with the 'laws of association'; but that in some cases, changes in their order, or a persistence in the same order, is said to be a result of 'will.' It is well known that Wundt and others assert the need of something beyond the mere association of ideas as being required for a scientific understanding of the so-called 'active' powers of mind, and that it was with this end in view that he postulated the existence of his so-called faculty of apperception, carrying with it activities of its own apart from the ordinary laws of the 'association of ideas.' Münsterberg has of late conducted two most important and skilful experimental investigations bearing upon the question of the existence or not of any such need. After a careful analysis of these researches Croom Robertson sums up the impressions they have produced in the following manner<sup>2</sup>:—"Taken together the two researches in their different way certainly point to one conclusion—that there is no such difference between so-called voluntary and involuntary intellection as Wundt's apperception theory (or any other like it) would make out."

(*b*) It remains then to consider how this superseding of one train by another, or continuance of an old train in spite of a tendency to wander, is or can be brought about; in order to indicate the kind of means by which what is called 'will' acts in directing or controlling the course of our thoughts. On this subject a few hints only can be given, concerning the different methods known to be adequate for the attainment of such ends.

(1) In the first place it should be stated that there is a sort of

<sup>1</sup> *Loc. cit.*, p. 142.

<sup>2</sup> *Mind*, 1890, p. 242. F. H. Bradley also expresses strong opposition to Wundt's doctrine of apperception. (See *Mind*, 1887, p. 366.)



antagonism between the mental activity of mere reminiscence, and that which is set on foot or maintained by external impressions—for the reason that the same central elements are called into activity in the two cases. Consequently, when any very interesting train of thought is being carried out we may become for the time 'self-absorbed,' and, during this period, much less receptive of external impressions, so long as they are not very intense. Moreover, when so engaged we always try to guard ourselves from the possible disturbing influence of external impressions of all kinds.

(2) Of the two opposing processes that which is externally derived (impressional activity) is decidedly more vivid and potent than that which is internally initiated (reflective activity): and it is this fact that enables us at any time ( $\alpha$ ) to interrupt and supersede a train of thought proceeding in accordance with the laws of association; or on the other hand ( $\beta$ ) to maintain it when we so desire.

In the one case, in order ( $\alpha$ ) to break in upon a train of association we may call into action some vivid sensorial impression, and we may repeat this operation till we have finally displaced the old train of thought; often simultaneously seeking the aid of bodily movements of one or other kind, which are potent in this direction by reason of the kinæsthetic impressions that ensue, and the new trains of association that may thereby be initiated.

While, in the other case, where ( $\beta$ ) we seek to maintain some train of thought in spite of a tendency to wander to other subjects, we call in the aid of language. That is, we repeat to ourselves some words essentially related to the subject of our thoughts, or we may sum up the stage at which we have arrived in words, thereby reinforcing the existing associational activity to which our attention is being given (through the mixed auditory and kinæsthetic impressions produced), and thus helping us to develop the subject on which we have been thinking. How influential such a mode of control is may be gathered from the added power of this kind that we obtain when we call into play the aid of writing, and thus help to maintain desired trains of reminiscence by means of additional reinforcing sense impressions of the visual and kinæsthetic order. Most of us must be familiar with the much greater ease with which we keep our thoughts along certain lines, and even develop them, when we are committing them to writing, as compared with what happens when we do not call into play this extra aid.

Thus, whether we seek to alter, or to maintain and develop, any particular line of thought, we call up as many new impressions as possible—of unlike kind when we wish to disturb or break in upon a previous line of reminiscence, but of like or of related kind where



we desire to strengthen and develop the previous associations upon which we have been intent.

What has been said above might seem at first sight to lend support to the views expressed by Bain,<sup>1</sup> that "in all voluntary control of the thinking trains there is a muscular intervention" of a direct kind, so that, as he contends,<sup>2</sup> "the retention of an idea in the mind is operated by voluntary muscles." This, however, cannot be admitted. Will operates, as we have seen, through the muscles only in an indirect way—that is, the muscular actions to which we resort give rise to ingoing impressions, and it is these which, according to their nature, may break up or may reinforce pre-existing trains of association. That is, there is a superseding or a strengthening of previous lines of thought, but in either case the effect still occurs in strict accordance with the laws of association.

It is perfectly true, therefore, that the excitation of muscles (more especially those of our sense organs or those concerned with speech) is an essential preliminary to the guidance or control of our thought processes, though this guidance or control seems not to be brought about as Bain would have us believe, or in such a way as to justify the language which he employs.

It must be borne in mind, in fact, that this voluntary muscular activity itself occurs as a sequence of one of the links in the association of ideas; and that the resulting control or change in the direction of our thoughts is brought about by the sensory results of the movements thus induced—that is, by auditory or visual in concert with kinæsthetic impressions reaching the brain, and again, according to their nature, and by the ordinary laws of association, helping either to change or maintain our previous line of thought.<sup>3</sup>

*The Nature and Extent of Voluntary Power over the Movements of our Bodies.*

The occasions for the exercise of voluntary movements of all kinds spring up, as I have pointed out, as ordinary links in the chain of association of our ideas.

Sometimes simple voluntary movements occur with all the rapidity, ease, and lack of effort that characterise a so-called ideomotor act, as when I resolve on certain occasions to sit or stand; to

<sup>1</sup> *Senses and Intellect*, 3rd ed., p. 421.

<sup>2</sup> *Loc. cit.*, p. 370.

<sup>3</sup> The view of Prof. Bain concerning the direct intervention of muscles in the control of our thoughts is, of course, intimately dependent upon his particular view as to feelings of movement being in great part 'concomitants of the outgoing current' and being realised in motor centres. This implies, of course, ideal recall in the same centres. Ferrier, strangely enough, though rejecting Bain's views in these latter respects, still adopts his derivative doctrine as to the



raise a glass of water to my lips when I am thirsty; or to eat when I am hungry. The initiatory causes of such actions are only a very little more complicated than those of simple spinal reflexes; the principal difference consisting, as Hartley long ago pointed out, in the fact that instead of being started by an external impression, they are initiated by ideas, although they may be more remotely prompted by internal or external impressions.<sup>1</sup>

At other times our voluntary actions only take place after more or less complicated previous processes of deliberation, or weighing of motives, and with much or little sense of effort. As W. James says<sup>2</sup>:—"In the dentist's chair one idea is that of the manliness of enduring the pain, the other is that of its intolerable character. We assent to the manliness, saying, 'Let it be the reality,' and behold it becomes so, though with a mental effort exactly proportionate to the sensitiveness of our nerves. To the sailor on the wreck one idea is that of the sore hands, and the nameless aching exhaustion of his whole frame which pumping involves. The other is that of a hungry sea engulfing him. He says, 'Rather the former,' and it becomes reality in spite of the inhibiting influence of the comparatively luxurious sensations of the spot in which he for the moment lies. . . . But in other cases both alternatives are images of mixed good and evil. Whatever is done has to be done against some inhibitory agency, whether of intrinsic unpleasantness in the doing, or of represented odiousness of the doing's fruits; the fiat has to occur against resistance. Volition then comes hand in hand with the sentiment of effort. . . . What does this effort seem to do? To bring the decisive volition. What is this Volition? The stable victory of an idea although it may be disagreeable, the permanent suppression of an idea although it may be immediately and urgently pleasant."

scope of volition and the mode in which it effects control over our thoughts (*Functions of the Brain*, 2nd ed., p. 461). Ribot seems to show a similar inconsistency. He rejects Bain's notion concerning the mode of registration of muscular sense impressions (pp. 66 and 71), and yet adopts his derivative views concerning the mode in which our thoughts are directed (*Attention*, p. 64).

<sup>1</sup> There is, in fact, no line of demarcation to be found between the cerebral reflexes known as "ideo-motor" acts, and simple or very familiar voluntary acts. It is often impossible to say which is the more appropriate designation for such acts. In regard to ideo-motor actions Müller said long ago, "The idea of a particular motion determines a current of nervous action towards the necessary muscles, and gives rise to the motion independently of the will." At times we may have the production of actions generally regarded as voluntary, taking place in this simple reflex fashion, and by aid of the same nervous mechanisms. This is also pointed out by Wundt (*loc. cit.*, t. i., p. 443).

<sup>2</sup> *The Feeling of Effort*, 1880, pp. 23 and 22.



At the same time that ideas and motives are in this way in conflict, we have half-aroused or nascent images revived in other sensory centres, representing the alternative actions or movements that would naturally be associated with this or that motive were it allowed to be operative. But it is only when one of these motives proves victorious—proves stronger, that is, than its rival—that all resistance is removed; we consent to its supremacy, and the result is that the revived image of its associated action becomes the immediate inciter of the real action which it foreshadowed.<sup>1</sup>

Thus it happens that, in order to bring about some present or prospective pleasure, or the avoidance of some present or prospective pain, we feel a desire to perform certain definite movements, the ideas or images of such movements being aroused, as James Mill originally pointed out, as almost sub-conscious sensorial links in the chain of our thought processes.

From what has hitherto been said two important conclusions may be drawn. First, that a sense of effort is associated with the conflict of ideas and motives which precedes the ascendancy of one of them; and that this sense of effort must, therefore, be an appanage of the activity of sensory centres and their annexes by the aid of which intellectual processes are carried on. There is no good reason for believing that the action of muscles has anything to do with the generation of this particular sense of effort.<sup>2</sup>

<sup>1</sup> See Herbert Spencer, *Princip. of Psychology*, 1870, vol. i. p. 496.

<sup>2</sup> Another source of the sense of effort is intimately associated with the activity of our muscles. Its origin is to be found in the ingoing sensory impressions of various kinds whose termini and seats of registration are the kinæsthetic centres in each cerebral hemisphere. This is fully admitted by Wundt, though not by Bain, to be one source of the 'sense of effort.' Some confusion has, I think, lately been introduced into this already sufficiently complex subject by Waller in a paper entitled "The Sense of Effort: an Objective Study" (*Brain*, 1891, pp. 179-249). This title seems to me peculiarly unfortunate, in more ways than one. Interesting and carefully worked out as many of the experiments are, they do not seem to me to touch the question of the origin of the 'sense of effort' as the term is understood by psychologists. I find therein no evidence to shake my opinions on this subject, and, moreover, find modes of stating my views to which I cannot assent. I hold that the functioning of muscle itself, of motor nerves, and of motor centres, are mere physiological processes devoid of subjective accompaniments; yet these are the structures in which Waller looks for after-effects that he assumes to be "the same as, or similar to, or parallel with, the material substrata of the concomitant sensifactory phenomena" (p. 192). That is to say, he seeks for the residual effects of what he says is variously termed "sense of effort," "muscular sense," "sense of movement," or "sense of innervation," in points along the track ABM of Fig. 1 (p. 191) with the whole of which, excepting one part, I say they have nothing directly to do. He seems to think that I consider the peripheral changes in this track as of most importance; while, as matter



Secondly, that the act of willing any particular movement consists essentially in a consent (after the balancing of reasons that may exist for or against) to the occurrence of such a movement; the movement itself being at the same time mentally prefigured by certain revived sensations—such revival representing, as James Mill said long ago, “the last part of the mental operation.” The occurrence or not of the movement is to a certain extent an accident, and one which, when it occurs, lies altogether outside the mental process itself.

Let us look, then, now a little closer at these last links in the chain of association—that is, at “the last part of the mental operation” which leads on to the performance of a voluntary movement. It consists in a revival of the idea or conception of the movement to be executed. This idea has always at least a twofold basis, though the actual production of the movement often requires a threefold excitation of sensory centres in immediate succession, as I shall presently show.

For limb and trunk movements the idea is composed of revived visual and kinæsthetic impressions which have previously been received during the execution of similar movements. The reawakened activity of these sensory centres affords the necessary stimulus and guidance for the reproduction of the movement—the molecular actions associated with their excitation evoke, that is, the related suitable activity of motor centres in the spinal cord. So that, as W. James puts it, “every representation of a motion awakens the actual motion which is its object, unless inhibited by some antagonistic representation simultaneously present to the mind.” The same kind of thing happens in regard to speech movements, only here we have the reawakened activity of auditory in conjunction with kinæsthetic centres starting the stimuli needful for calling into activity the proper motor centres for speech in the bulb.

of fact, I say, that the peripheral changes in muscle which he investigates, have nothing directly to do with any of these psychical phenomena. I hold that the contraction of muscles forms the occasion merely for the birth of a series of ingoing impressions starting from the peripheral ramifications of afferent nerves in muscles, joints, skin, etc., which are conveyed along the route MCA, and are consciously realised in the centre A. He calls this latter an efferent or motor centre, and thinks the psychical events he names above are dependent mainly upon its molecular activity. This is exactly what I have long since said, with the important exception that I maintain the centre in question to be an afferent one (see p. 190). I find in Waller's paper no new independent evidence of any kind bearing upon this latter problem; and much in his mode of presenting the old evidence to which I cannot assent. His paper, in my opinion, must be taken solely as a contribution to what is known as “physiological fatigue”—as he, in fact, would seem to indicate by his sub-title.



I would only add here that this view of James Mill<sup>1</sup> is also the doctrine taught, as to the mode of production of voluntary movements, by Lotze<sup>2</sup> and by Herbert Spencer<sup>3</sup>; that it has been advocated independently by W. James and myself since 1880; and later by Münsterberg,<sup>4</sup> Horsley<sup>5</sup> and others.

<sup>1</sup> *Analysis of the Human Mind*, 1829, vol. ii., p. 254.

<sup>2</sup> *Medicinische Psychologie*, 1852.

<sup>3</sup> *Princip. of Psychol.*, 1st ed., 1855, p. 613, and 2nd ed., 1870, vol. i., p. 496.

<sup>4</sup> Münsterberg's theory (see *Mind*, 1888, p. 463), concerning the "muscular sense" and its relation to voluntary movements, is identically the same as that published independently by Prof. James and myself in 1880, though this seems not to have been recognised by Croom Robertson, since he speaks (*Mind*, 1890, p. 525) of it "as mediating between the opposed theories that have thus far occupied the ground." His attempt in the same place to claim some justification for the view of Wundt and Bain seems to me not very successful. Thus he says (p. 527):—"The difference on the afferent side of the system between sensation and representative image is allowed to be one that depends only or, at least, mainly, upon degree of excitation: this being (normally) greater when determined from the periphery. How, then, should there not be a corresponding difference of representative and presentative experience on the *efferent* side when the cerebral process in one case is not, and in the other is, effective in producing overt muscular contraction?" My answer to this is twofold. In the first place, I say that the centres to which his query refers do not stand on the *efferent* side of the nervous system; they (*i.e.*, the kinæsthetic centres) are the cortical termini for a definite class of impressions, and, like the visual and the auditory, are true afferent centres (see p. 32). And, secondly, I would say that his analogical argument sets up a claim for subjective processes in association with the functioning of efferent centres, whilst I, in common with James, Münsterberg, and others, maintain that no independent evidence exists to show that such functioning is ever by itself associated with a subjective phasis. His eyes are open to the possibility of this latter retort. He sees, in fact, that his analogy would be rendered nugatory by the denial of subjective phenomena in association with the functioning of motor centres—but he omits to mention that this heresy is maintained by James and Münsterberg as well as by myself. I fail to see, moreover, the cogency of his objections to the use of the term 'kinæsthesia,' and its derivatives. I would remind him that the term 'muscle sensation,' of which he seems to approve as an alternative, refers to only one element entering into the complexus of sensations produced in us whenever we make movements; and that the various components of this complexus are always simultaneously subject to revival as guides for future movements. Surely, if groups of impressions like this always occur together, and are always revived together for the carrying out of important physiological processes, that is a sufficient justification for speaking of them under some common name. And if we bear in mind the fact that such impressions, like all others, are when realised, as Croom Robertson points out, always "overlaid by representation," it may be seen that we are thereby enabled almost intuitively to interpret them as meaning movements of this or that part of our body. How could we, then, better convey the desired meaning than by speaking of them as 'kinæsthetic' impressions?

<sup>5</sup> *The Nineteenth Century*, June 1891, p. 857.



I have always considered that in the conjoint sensory revivals, or "ideas of movement," the visual or the auditory impression, as the case may be, is the first to be revived, and that the renewed activity in one or other of these centres is passed on through associating fibres to functionally related portions of the kinæsthetic centres. The activity of these latter centres seems to me to be almost if not always evoked in this secondary manner, although for the actual production of the suitable movements the functioning of the kinæsthetic centres is all important. They are situated in the cortex at what has been termed the "bend of the stream"—they are, indeed, the last portions of the cortex to be aroused in the performance of voluntary movements, and from them actually issue the fibres (viz., those of the pyramidal tract) which convey the appropriate incitations to the real motor centres situated in the bulb and in the spinal cord.<sup>1</sup> Here, then, as elsewhere, motor centres produce (through the intermediation of nerves and muscles) movements which are qualified as to nature, range, and force by the precise nature of the stimuli which they receive from sensory centres.<sup>2</sup>

How all-important these sensory activities are for the production of voluntary movements is well shown in many cases of brain disease leading to speech defects. Thus, I have had under observation from time to time since 1878 a man who then became paralysed on the right side, and whose powers of expression by speech and writing were at the same time disordered in a remark-

<sup>1</sup> I purposely, for the sake of simplifying the problems under discussion, omit all reference here to the co-operative action of the cerebellum in the actual production of movements.

<sup>2</sup> I am sorry that Dr. Ferrier has again not taken the trouble to state my views correctly. In his most recently published work he quite misrepresents them by stating that I have taught that the kinæsthetic centres are aroused as "independent centres of activity, irrespective of the stimuli from the sensory centres of the cortex" (*Cerebral Localisation*, 1890, p. 147). This supposed view of mine he then proceeds to refute by quoting the experiments of Marique, confirmed by Exner and Paneth, to the effect that "when the motor [kinæsthetic] centres have been completely isolated, by section of the fibres which associate them with the sensory centres of the cortex, paralysis results of precisely the same character as that which occurs when they are completely extirpated. Marique proved that the same contractions were obtainable on electrical irritation of the respective centres after, as before, isolation, showing that they still retained their excitability and connection with the pyramidal tracts." So far from being opposed to my views, it will be seen that these experimental results are in exact accordance with what I have always said in regard to the mode in which the activity of the kinæsthetic centres is evoked. See, for instance, *The Brain as an Organ of Mind*, 1880, p. 593, and elsewhere; also *Brain*, Ap. 1887, pp. 7, 57, and elsewhere.



able manner.<sup>1</sup> The principal persistent defect in this man has been a damage to the commissural or associating fibres connecting the visual and the auditory word centres, so that he is unable to perform any movements that require for their initiation and guidance the successive conjoint activity of these centres: showing how absolutely dependent our thought processes are upon the integrity of the associational paths. Thus, a blockage occurred twelve years ago in the lines of communication between the auditory and the visual centres; and as a consequence this man cannot name objects at sight, or read aloud words or even letters; though he recognises them perfectly, can read to himself with comprehension, and can repeat names of things, or words of any kind, immediately that he hears them. Again, though he has now learned to write with the left hand, and he can without hesitation copy in a rude way any words that are written on the paper before him, he cannot write a single word spontaneously or from dictation—not even a letter. The auditory stimulus will not pass along the blocked track,<sup>2</sup> so that there is no means of rousing the related portion of the visual centre or, consequently, of the kinæsthetic centre. Along this route the idea of writing movements cannot be revived, and as a result, the man cannot make even an attempt to form a single letter. But his puzzled look and passive state give place to one of pleasure when he sees the word written, and he immediately proceeds to copy it; just as, in the previous trial, his eager tentative look at the word he seeks but is unable to articulate, is followed, the instant he hears it pronounced and thus receives an auditory revival, by its correct utterance. A block in the commissures connecting the auditory with the related glosso-kinæsthetic centre would similarly prevent reading or naming at sight, as it would also prevent all spontaneous speech; and a block between the visual and the related cheiro-kinæsthetic centre would similarly render writing from dictation or spontaneous writing impossible.<sup>3</sup>

Here, then, we get at the very roots of Will. The sources of the power employed for arousing the appropriate contractions of our muscles is to be found in the molecular activities issuing from these sensory centres. This is shown by the fact that we have, in such cases as I have above referred to, persons willing but unable to

<sup>1</sup> His case is detailed in *The Brain as an Organ of Mind*, p. 642.

<sup>2</sup> In silent thought, and therefore for spontaneous writing also, the first memory of the word to be revived is, I believe, in the great majority of persons, that which is registered in the auditory centre.

<sup>3</sup> See a paper "On Different Kinds of Aphasia," *Brit. Med. Journ.*, Oct. 29, and Nov. 5, 1887.



successfully execute certain speech movements at the instigation of appropriate visual impressions, though they retain the power of producing the movements in response to appropriate auditory stimuli; and, on the other hand, persons unable to produce writing movements at the instigation of auditory stimuli, which they are able at once to evoke at the bidding of visual impressions.

The same kind of conclusion as to the source of the energy employed in the production of muscular movements generally has been forced upon Gotch and Horsley, during their late important electrical investigations concerning the excitability of different regions in the brain and spinal cord, which in 1890 formed the subject of the Croonian Lectures before the Royal Society.<sup>1</sup> I note, however, that even these investigators speak of the cerebral kinæsthetic centres as being on the "efferent" side of the nervous system.<sup>2</sup> This seems to me an erroneous interpretation. They are, I think, afferent centres in every way analogous to the afferent centres situated in the spinal cord.<sup>3</sup> The so-called "motor centres" of the cortex were not, of course, originally supposed to be termini for afferent impressions; when first discovered they were said, and they are still maintained by Ferrier to be, true "motor centres." Now, however, in spite of the different interpretation which has been given of their functions, many still cling to the belief that the centres in the Rolandic area must be motor centres because internuncial fibres connect them with the real motor centres in the bulb and spinal cord—and because, therefore, 'motor incitations' must pass along such internuncial fibres.<sup>4</sup> "What initiates a motor process," they say,<sup>5</sup> "is to all intents and purposes motor." Or, as Ferrier<sup>6</sup> puts it, "centres immediately concerned in effecting voluntary movements" are "as such motor." Both these statements I believe to be altogether erroneous. As I have said elsewhere,<sup>7</sup> "The plan on which nervous centres generally are constructed, of whatsoever grade, makes it essential that the stimulus which awakens the activity of a 'motor' ganglion or centre shall come to it through connecting fibres from a 'sensory' ganglion, centre, or knot of cells—that is, from cells which stand in immediate relation with ingoing fibres." Thus, we

<sup>1</sup> *Phil. Trans.* 1891, B, pp. 447, 449, 478 and 509.

<sup>2</sup> *Loc. cit.*, p. 342.

<sup>3</sup> *Loc. cit.*, p. 479.

<sup>4</sup> Since 1880 I have always restricted the term 'internuncial' to fibres which connect an afferent with an efferent centre; employing the term 'commissural' for those fibres that connect two afferent or two efferent centres with one another. (See *Brain as an Organ of Mind*, p. 586.)

<sup>5</sup> W. L. Mackenzie, in *Brain*, 1887, p. 433.

<sup>6</sup> *Functions of the Brain*, 2nd ed., p. 348.

<sup>7</sup> *The Brain as an Organ of Mind*, p. 585.



should not call a cortical centre for afferent impressions 'motor,' any more than we should call the group of ganglion cells on the afferent side of a spinal reflex arc 'motor.' In each case the nerve cells that receive the afferent impulses are in association with channels which

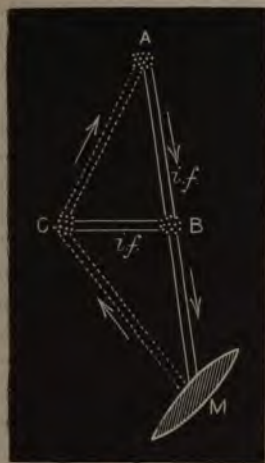


FIG. 1.

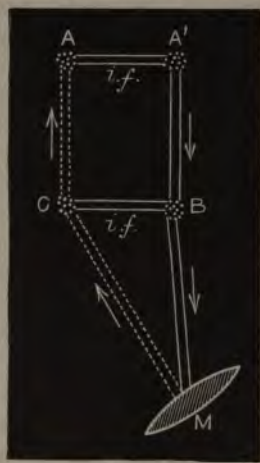


FIG. 2.

FIG. 1.—Diagram illustrating the origin of kinæsthetic impressions (so far as they come from muscle), and their relation to the production of voluntary movements, in accordance with my views.

A. Cerebral afferent (kinæsthetic) centre, receiving and registering ingoing impressions from muscle by way of an afferent spinal centre C; *i.f. i.f.*, two sets of internuncial fibres; B, spinal efferent or motor centre, which receives incitations from A, whence they are sent on to the muscle M.

∴ A is an afferent centre in the same sense that C is an afferent centre, and each of them may convey 'motor incitations' along internuncial fibres to the motor centre B.

FIG. 2.—Diagram illustrating the origin of muscular sense impressions and their relation to the production of voluntary movements, in accordance with the views of Dr. Ferrier.

A. Cerebral afferent (tactile) centre receiving and registering ingoing impressions from muscle by way of an afferent spinal centre C; A' a supposed motor centre, which operates through commissural fibres upon the spinal motor centre B.

∴ No psychical processes are believed by either of us to be associated with the functional activity of the tracks represented by unbroken lines and the centres lying in their course.

I say that the functions attributed by Ferrier to A' are really performed by A as in Fig. 1, and that if A, A' existed as in Fig. 2, there ought to be two sets of excitable areas in each hemisphere.

convey 'motor incitations'; and in each case the stimulation of such internuncial fibres, or of the centres from which they proceed, would



give birth to definite movements. The course of these internuncial fibres is for the most part horizontal in the spinal cord, though more rarely it may be an ascending one. But from the kinæsthetic centres in the brain the course of the internuncial fibres is downwards (in the pyramidal tract); hence the current is commonly spoken of, truly enough, as an "outgoing current"; but with the effect, apparently, of fostering some confusion in the minds of not a few persons. It was apparently under the influence of some such confusion that W. L. Mackenzie,<sup>1</sup> a writer above quoted, penned the following sentences. If "we confine consciousness to sensory processes, then since sensory may excite motor processes, we must imagine consciousness suddenly ceasing on the nervous bridge—the internuncial fibres—between a sensory and a motor centre. If this be so the time has come for abolishing altogether the distinction of sensory and motor cortical centres; they are all sensori-motor." This seems to me to be an invalid conclusion, based upon a misconception as to the mode in which motor centres generally are stimulated. Certainly there is no more reason why centres on the afferent side of the nervous system which happen to be situated in the cerebral cortex should be called 'sensori-motor,' than that such a term should be applied to similar afferent centres situated in the spinal cord. And yet it would be only upon such a basis that justification could be found for the oft-quoted view of Hughlings-Jackson, cited by the same author (*loc. cit.*, p. 432) that "the physiological substratum of every mental process is a sensori-motor process."

From what has now been set forth, as well as from the facts and arguments detailed in a previous communication to this Society,<sup>2</sup> it seems to me quite clear that there is no reason for postulating the existence of cortical motor centres for the production of voluntary movements; that whatever the mode in which simple movements are produced, that is, whether they are voluntary or reflex, only one set of motor centres is called into play, and that these motor centres are situated in the bulb and in the spinal cord; and, further, that the functioning of motor centres generally is attended by no psychical accompaniments. In reference to this last point I have said elsewhere<sup>3</sup> :—"No ideal reproductions seem ever to take place in such centres; they are roused into activity by outgoing currents, and, so far as we have any evidence, the induction

<sup>1</sup> *Loc. cit.*, p. 432.

<sup>2</sup> In part reprinted as *Appendix A*.

<sup>3</sup> *The Brain as an Organ of Mind*, p. 599. The lack of sensibility accompanying the action of motor centres has now been experimentally demonstrated by Gotch and Horsley (*loc. cit.*, p. 510).



in them of molecular movements which, immediately afterwards, issue through cranial and spinal motor nerves to muscles, are simply physical phenomena. These processes are apparently as free from subjective accompaniments as are the actual molecular processes thereby incited in the muscle itself." In fact the molecular motions that occur in motor centres "seem to lie even more truly outside the sphere of Mind than the molecular processes comprised in the actual contraction of a muscle; these latter are at least immediately followed by 'ingoin' impressions, whilst so far as we know—that is so far as any evidence exists—the former are not."

On the other hand, in common with James, and in part with Münsterberg and others, I maintain that all the sensations resulting from movement are derived from ingoin impressions; that such sensations are realised and revivable in idea in special sensory centres in the Rolandic area of the cortex, which are in intimate associational relation with visual, auditory, and other sensory centres; that the functional activity assumed to be performed by voluntary motor centres in the Rolandic area is really carried out by these sensory centres of kinæsthetic type, similarly located; so that in "the association of ideas" generally, as well as in the processes of Attention and Volition, we have merely to do with the psychical activity of sensory centres and their annexes—and not of motor and sensory centres, with the former often dominating. Thus I hold that the process of Attention is in its essence sensory, though with inseparable motor accompaniments; while Volition, so far from "existing only in connection with the active organs, that is, with the muscular system,"<sup>1</sup> seems to represent merely some phases in the "association of ideas," and, as W. James puts it, is rather "a psychic, or moral fact pure and simple, and is absolutely completed when the intention or consent is there"—he also maintaining that the supervention of motion upon its completion is a supernumerary phenomenon belonging to the department of physiology. The phenomena of Volition are, therefore, not the work of any special faculty or mysterious entity, and are not carried on in motor centres; they are merely certain exemplifications of intellect in action; so that ample justification is found for the dictum of Spinoza, "Voluntas et intellectus unum et idem sunt." Anything separate to be known as Will is, in fact, a mere phantom—a kind of psychological ghost.

<sup>1</sup> Bain, *The Senses and the Intellect*, 3rd ed., p. 559.



## APPENDIX C.

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### IS THERE A DOUBLE REPRESENTATION OF TOUCH AND COMMON SENSIBILITY IN EACH CEREBRAL HEMISPHERE ?

THIS is a question which in the present state of our knowledge demands some careful consideration. The views that have been hitherto expressed in regard to the representation of touch and common sensibility have been various and more or less conflicting in their nature. The whole question is too complicated to enable me to enter upon it in detail here. I can only deal with the question in a brief manner, partly with the view of suggesting some considerations that will tend perhaps to diminish the conflicting nature of the evidence as it at present stands; and partly in order to suggest the points to which particular attention should be given in future by clinicians, with the view of removing remaining differences of opinion on this important subject.

If we omit minor details, the views that have hitherto been expressed may be ranged under one or other of the three following heads :—

(1) That the so-called motor areas of the cortex contain also the representation of cutaneous sensations; or, in other words, that the Rolandic area is a sensori-motor region, and that the representations for the different parts of the cutaneous surface are, in the main, identical in site with those of the corresponding motor segments.

This view is based principally on clinico-pathological evidence, though it is thought by some also to be supported by experiments on animals. It is the view of Hitzig, Nothnagel, Exner, Luciani and Sepelli, Munk, Schiff, Starr, Dana and others; and full references to the literature of the subject are to be found in a paper by the last named author on "The Cortical Localisation of the Cutaneous Sensations." <sup>1</sup>

<sup>1</sup> *The Journal of Mental and Nervous Diseases*, Oct. 1888.



(2) That touch and common sensibility are registered in the limbic lobe, that is in the gyrus fornicatus and the hippocampal region.

This view is based almost wholly on experimental evidence. It is the view of Schäfer and Horsley, and of Ferrier. There are important differences, however, between the views of these investigators. Thus, Ferrier goes so far as to deny that there is any sensory representation in the Rolandic area,<sup>1</sup> and expresses the opinion that all kinæsthetic impressions are mixed inextricably with tactile impressions in one and the same cortical terminus. No such views are held by Schäfer and Horsley; they are both prepared to admit the registration of muscular sense impressions in the Rolandic area; and the latter, as we shall presently see, goes beyond this, since he believes that other modes of sensibility are registered in this same region.

(3) That touch and common sensibility are registered in the limbic lobe and also in the combined Rolandic and marginal area; and that the latter region is also the seat of registration for muscular sense impressions.

This view has, as yet, so far as I know, been expressed only by Horsley in an able and interesting article "On the Analysis of Voluntary Movement,"<sup>2</sup> but it is the interpretation which I am disposed to believe will ultimately prevail. The experimental evidence in favour of the view that the limbic lobe is the seat of registration for impressions of touch and common sensibility is very strong<sup>3</sup>; on the other hand, that some amount of a similar representation exists in the Rolandic area seems to be no less strong. Dana, for instance, has analysed the records of 142 cases in which lesions occurred in this region, and as a result he says<sup>4</sup>: "I am certain that no amount of scrutiny can explain away the numerous cases in which superficial cortical lesions have caused monoplegias and monoanæsthesias." It remains for future investigators, however, more accurately to define the kind and extent of impairment of sensibility that coincides with cortical lesions in the Rolandic and marginal areas.

So far as Horsley's observations go, the kinds of impairment of

<sup>1</sup> *Functions of the Brain*, 2nd ed., 1886, pp. 377 and 379.

<sup>2</sup> *The Nineteenth Century*, June 1891, p. 863. The views expressed in this article are quite in accord with my own, save in regard to one rather important point. I look upon the kinæsthetic centres as sensory, and not as "sensori-motor" centres.

<sup>3</sup> See the "Memoir of Horsley and Schäfer," *Phil. Trans.*, vol. clxxix., B, p. 19.

<sup>4</sup> *Loc. cit.*, p. 18 (of reprint).



sensibility met with as a result of cortical lesions in this so-called motor area are these<sup>1</sup>:—(a) Insensibility to slight tactile impressions; (b) inability to localise correctly moderate tactile impressions; (c) loss of muscular sense. Further on<sup>2</sup> he calls particular attention to the fact that the sensory impressions that are defective (or which in irritative lesions are in excess so as to cause different degrees of discomfort or pain) are those coming from deep structures, such as muscles, joints, and bones. He says, "It is remarkable, though of course most natural, how the mass of sensory impressions under these circumstances, viz., of lesion in the Rolandic region, relate to the deep structures." Dana also is of the same opinion as Horsley as to the fact of the impairment being slight, since he says<sup>3</sup>: "The comparatively slight involvement of sensibility in lesions of the motor cortex has yet to be satisfactorily explained." One explanatory suggestion, however, that amongst others he makes, is this: "It is just possible that there is some sensory function in the limbic lobe."

This third view that there is a double representation of touch and common sensibility in the cerebral hemisphere is certainly one which at first sight presents some difficulties in the way of interpretation. Dana says,<sup>4</sup> "It is hard to conceive of a sensory mechanism so complicated and clumsy as that required by a hypothesis of compounded sensory centres, one in the limbic lobe and one in the motor cortex; and no one has, I think, ventured to explain how such an anatomical arrangement could be put in harmony with the psychology of sensation." I will, therefore, now throw out a few hints with a view to show that such an arrangement is not quite so anomalous as it may at first appear; and that however difficult some recorded facts may be to understand (if they are really facts) concerning the degree of impairment of sensibility that has been met with in association with lesions limited to the cortex in the Rolandic area, yet some such double representation may be looked for in accordance with my views.

It must be borne in mind that the sensations accruing from movement are in part superficial cutaneous impressions, and in part

<sup>1</sup> *Loc. cit.*, p. 865.

<sup>2</sup> *Loc. cit.*, p. 869.

<sup>3</sup> *Loc. cit.*, p. 19. He thinks that the limbic lobe, or some part of it, is in the main the seat of olfactory sensibility. Dana also thinks there is some support for the view that "the seat of muscular memories is in the inferior parietal lobule," as some others have held. But the few observations on which this doctrine rests are, as C. K. Mills says (*Brain*, Oct. 1889, p. 389), "not convincing."

<sup>4</sup> *Loc. cit.*, p. 17.



deep impressions of various kinds, emanating from muscles, fasciæ, tendons, and articular surfaces. A mixed body of impressions of this kind is evoked as a result of every movement, and this group of impressions is revived in memory as though it were a simple impression, immediately anterior to the reproduction of each of such movements. The "idea of a movement" about to be executed is, as we have seen, a concurrent memorial recall of certain visual impressions previously produced by such a movement, together with a similar recall of the body of impressions which the movement itself had occasioned. All the constituents of this latter group of impressions, even including those of a cutaneous order, may be considered to be 'intrinsic' in their origin.

But important differences separate this synchronous and fused group of impressions from all 'extrinsic' sensorial impressions. In reference to this I have elsewhere said<sup>1</sup>:—

"Ordinary extrinsic sensorial impressions commonly play the part of instigators to movement. Thus impressions of smell, sight, hearing, touch and taste, are either the immediate or the remote instigators of the great majority of the movements executed by animals."

"The movements so stimulated are in almost all cases of a more or less purposive type, directed, that is, towards the attainment of some end."

"During the whole time that such movements are being evoked, the animal is constantly receiving those groups of mixed afferent impressions which we have styled 'kinæsthetic,' called into existence by the mere movements themselves."

"Kinæsthetic impressions are never instigators of movement in the same sense that olfactory impressions may be instigators of movement. Visual impressions and auditory impressions are not only frequent instigators of movement, they are also respectively all-important guides for certain classes of movements. From a functional point of view kinæsthetic impressions are guides only; these functional uses are, however, co-extensive with movements themselves, since in conjunction either with visual or with auditory impressions they act as guides for all sorts of movements. As it is with visual and auditory, so is it with kinæsthetic impressions, their guiding influence in the production of movements is brought to bear, partly under the form of actual sensations, and partly under the form of revived impressions (the memories of past activity)."

Thus, in my opinion, we have in the cerebral cortex an extended

<sup>1</sup> *Appendix A*, p. 136.



register of two kinds of sensory impressions—those (*a*) which primarily *incite* to movement, and those other (*b*) intrinsic sensory impressions (kinæsthetic) resulting from such movements that constitute the subsequent *guides* for the re-execution of similar movements. And just as the different kinds of sensory centres belonging to the first set are brought into intimate relation with one another by means of commissural fibres, so also are the kinæsthetic centres similarly connected with each of the other sensory centres.

Now in 1886, at the debate before the Neurological Society, while contending that the so-called ‘motor centres’ in the Rolandic area were in reality muscular sense centres, I was content to believe that cutaneous impressions were wholly registered (as the then new experimental evidence seemed to show) in the limbic lobe.<sup>1</sup> But at the present time, when clinico-pathological evidence has rendered it so much more certain that in addition to muscular sense impressions touch and common sensibility are, to some extent, registered in the Rolandic area, it seems to me not at all improbable that there may be in reality a double cortical representation of these modes of sensibility.

The best provisional explanation of known facts would, indeed, seem to be this. It may be supposed that the limbic lobe is the principal register for touch and common sensibility; but that the continuously adjacent marginal and Rolandic areas are the independent seats of registration of kinæsthetic impressions as a whole, and consequently of those tactile and deep modes of sensibility which enter into the kinæsthetic complexus of impressions. The nature of the sensory defects recognised and specified by Horsley<sup>2</sup> as resulting from cortical lesions of the so-called motor area are, it will be seen, almost entirely in accord with what might have been expected by the holders of such a view as this. Further, this view meets the difficulty referred to by Dana, as to the comparatively slight involvement of sensibility in lesions of the so-called motor cortex, which is so difficult to be accounted for by him on the supposition that this area is the principal seat of registration for cutaneous impressions.

Again, any surprise that might at first be felt on account of the great extent of the area of the cortex occupied as a register for kinæsthetic impressions, as compared with that of the limbic lobe in which touch and common sensibility are registered in so far as they are of extrinsic origin, and not concerned with the immediate guidance of muscular movements, may, I think, after a little reflection be greatly diminished. As I have already said, “Seeing that

<sup>1</sup> See *Appendix A*, p. 164.

<sup>2</sup> *Ante*, p. 196.



kinæsthetic impressions must be as numerous and as endlessly diversified in their kinds and combinations as movements themselves, it follows that large tracts of the brain ought to be concerned with their registration for future use in the guidance of all kinds of voluntary movements." It must not be forgotten, moreover, that kinæsthetic impressions enter largely into the composition of nearly all our visual and tactile sensations. Movements of the eyes, and movements of the hands and fingers, vastly increase the range of possible visual and tactile sensations, and enter as it were into their very structure.

Beyond all this, for the explanation of the large extent of the cortex of the cerebral hemispheres occupied by the kinæsthetic centres, we need look only to the importance of the functions which they subserve—to the fact that they do all the work formerly supposed to be achieved by special motor centres, besides affording that sensorial guidance for all kinds of movements which has been credited to the intervention of the limbic lobe.







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